Issue 117 April 2026 £4.15

UltraMarine

Pure Inspiration for Marine Hobbyists

Our UK Shop Tours Continue...
4 years on since our last visit, are Essex-based **AAC Ltd** still our "Top of the UK Shops"?

Venture Into the Microverse
John Clipperton enters a realm of reef "mini-beasts" with the help of a useful new piece of equipment

50+ Years In The Making
Campbell Robertson takes us on a reef-keeping journey which has finally produced a display to be proud of.

Capital reef *revisited*

*We sit down for a cup of tea with "Godfather of UK reef-keeping", **David Saxby**, and catch-up on developments to his legendary display system over the last 4 years!*

PLUS news, reviews... and lots more!

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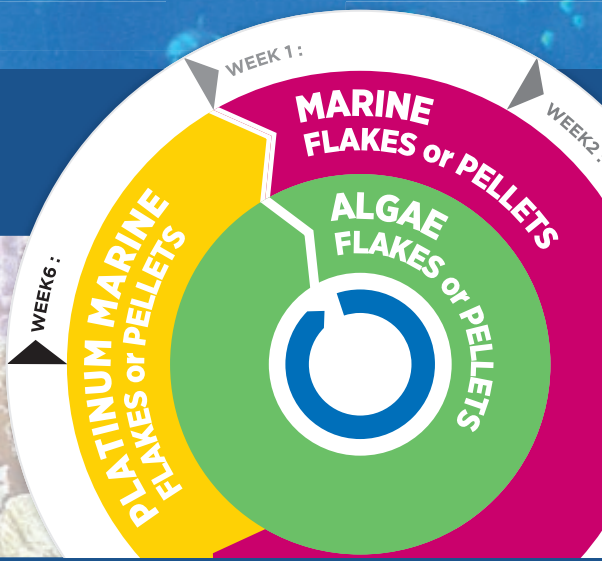

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Welcome

to UltraMarine

Greetings to you, UltraMarine reader!

As ever, putting this issue together has been a real challenge… but still good fun at the same time. I was hoping to run a piece by OATA in this issue but sadly, (through no fault of their own), they haven't been able to finalise this piece just yet. I'm hoping it will be green-lighted for next issue though. Given this, I hope you don't mind my re-run of an article "from the archive". It's actually a great piece by Kenneth Wingerter and I found that I benefited from a second read personally (especially given I'm establishing a new tank a we speak). On this subject, I managed to put a "Part 2" piece on my own tank together after skipping last issue due to an algae outbreak. In short, it's definitely looking better, but still a long way to go!

I can't go without mentioning this issue's road trip of course. It's been 4 years since I last did this trip and, as last time, all I can say is "wow, what a weekend!". Arguably the best private reef system and then best reef store in the UK over the course of 2 days… need I say more?! All-in-all, it was certainly a demanding trip (mainly in terms of doing justice to each), but worth it to bring you the very best the UK has to offer.

Next issue I am due to head up to Scotland so I'll be flopping in a chair and recuperating for a few days once this issue is released… then straight back to it. No rest for the wicked, as they say! :)

John

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Contents

Issue 117 April 2026

Marine News

Products & Services • Science & Conservation • Shops • Public Aquaria

Science & Conservation

Antibiotic Treatment Is Safe For Stony Coral Disease

An antibiotic treatment used in various regions of the Caribbean and on Florida's Coral Reef to address stony coral tissue loss disease has been confirmed by scientists to have no adverse side effects.

Dr. Karen Neely applies antibiotics to a coral infected with stony coral tissue loss disease in the Florida Keys. Credit: Nova Southeastern University

Since 2019, Nova Southeastern University scientist Karen Neely and her team from the University of Florida and the U.S. Geological Survey (USGS), have been among several groups applying an in-water topical antibiotic paste to diseased lesions on wild corals in Florida.

This treatment has led to remarkably high survival rates of corals and the preservation of living coral tissue. By May 2025, over 31,000 corals have been treated with the paste in Florida's Coral Reef, which is the only barrier reef system located in the continental United States. Initially, the application of antibiotics in a natural environment raised concerns about the potential increase of antibiotic-resistant genes in corals and the possible disruption of the microorganisms that inhabit and surround corals.

However, the most recent research findings indicate that there has been no disruption to the microbial community and no alterations in antibiotic-resistant genes after the treatments. These results have been published in the journal Coral Reefs.

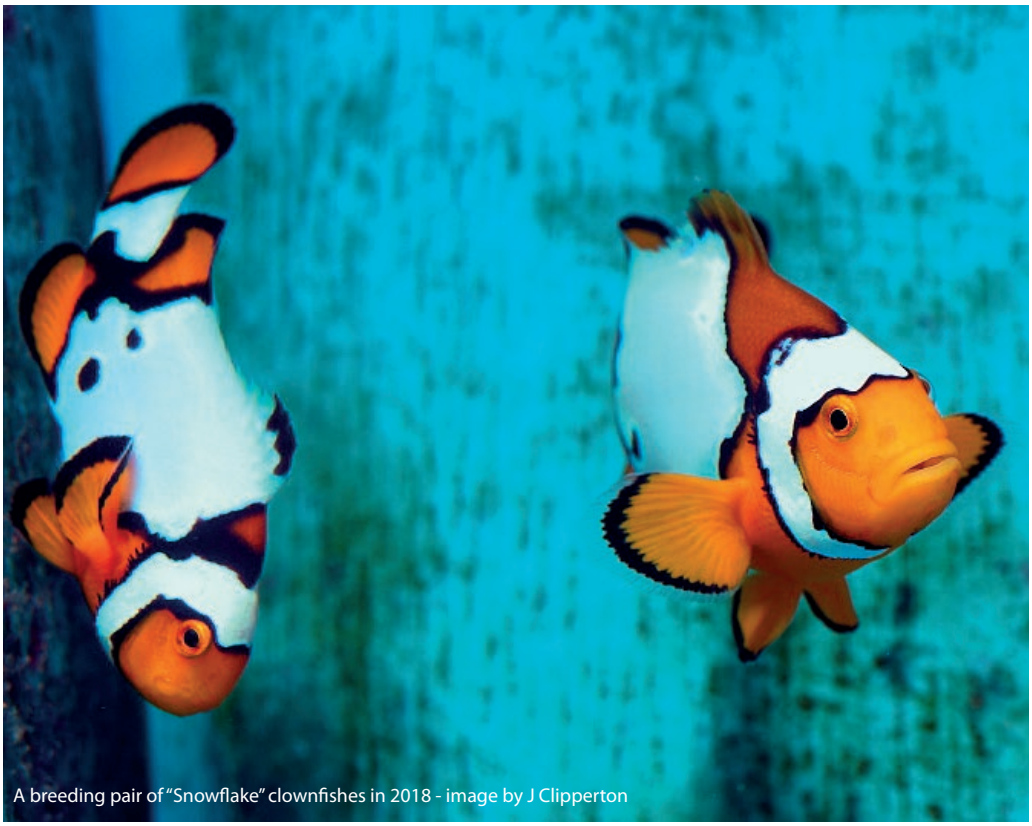
"We now have evidence that this treatment not only saves corals, but does so safely," Neely stated. "That's crucial as scientists seek tools to mitigate the loss of reefs."

Stony coral tissue loss disease has significantly impacted stony coral species in the Caribbean, affecting more than 20 of the approximately 45 species of reef-builders and five of the Caribbean coral species listed as endangered in the U.S. Since its emergence in South Florida in 2014 and its spread throughout most of the Caribbean by 2017, the disease has resulted in mortality rates ranging from 67% to 100% in some species, leading to considerable declines in coral cover, biodiversity, and ecosystem functionality.

The results confirm the effectiveness of disease intervention strategies implemented on Florida's Coral Reef. As scientists and managers persist in their efforts to safeguard reef systems, NSU researchers indicate that the study provides proof of science-driven solutions that can aid in the preservation of coral reefs for future generations, as well as for ecosystem services and economic benefits.

Snowflake Clownfish Reveals Pattern Formation Process Is Older And More Complex Than Thought

More than twenty years after the captive creation of the "snowflake" variant of the false percula clownfish *Amphiprion ocellaris*, a team of researchers from the Okinawa Institute of Science and Technology (OIST), Academia Sinica in Taiwan, Kyoto University, and the University of Virginia has disclosed the specific gene that causes this transformation. Along the way, they have also discovered insights into the larger enigma of how nature forms consistent patterns. Their research was published in *Nature Communications*.



A breeding pair of "Snowflake" clownfishes in 2018 - image by J Clipperton

"Conceptually, it should be simple," said Professor Vincent Laudet from the Marine Eco-Evo-Devo Unit at OIST. "But in practice, it's mysterious. How does a cell know whether to be black, white, or orange, in a way that consistently creates clearly organised patterns at a macroscale? The Snowflake clown has now not only pointed us to a genetic mechanism, but also to a universal framework for studying pattern formation across species."

"The Snowflake clown has now not only pointed us to a genetic mechanism, but also to a universal framework for studying pattern formation across species."

As most marine hobbyists will know, Snowflake clowns (or any other of the multitude of designer strains that now exist) are like "standard" clownfish in all respects except for their unusual patterning, making them the perfect model organisms for investigating the genetics of pigmentation. To understand why they look the way they do, the researchers turned to another fish but a freshwater one this time. *Danio* genus "Zebrafish" are well-studied for their horizontal lines, which stay proportional in size and spacing as the fish grows. Thanks to another mutant, the "Leopard" danio, which develops spots instead of stripes, researchers have previously identified one of the genes implicated in pattern formation. It encodes a specific gap junction protein that essentially serves as a telephone wire between cells, allowing them to exchange information in the form of electric current and small molecules.

When the team compared the genomes of Snowflake to wild-type clownfish, they discovered a striking similarity. Laudet says, "We saw it straight away—Snowflake had a mutation in exactly the same gap junction gene as Leopard danio!"

Nonetheless, this revelation raised more questions than it answered. In danios, the gap junction protein was believed to play a key role in guiding the growth of what are known as Turing patterns. Named after the renowned British mathematician Alan Turing, this model explains how the protein facilitates stripe formation by inhibiting close-range interactions while encouraging long-range connections among pigmentation cells, resulting in the emergence of consistent patterns in zebrafish.

However, the Turing model fails to explain the patterning in clownfish, as their stripes maintain a fixed sequence and position throughout their lives, indicating that information is instead shared to determine where and when a bar should appear.

The study's first author, Dr. Marleen Klann of the Marine Eco-Evo-Devo Unit, continues, "We found that the gap junction protein is not specific to Turing patterning in zebrafish, and showed that it ensures clear cell-to-cell communication more generally. It is evidently also much older than we thought: freshwater zebrafish and saltwater anemonefish diverged more than 200 million years ago."

Reefing Round-Up - February / March 2026

In a freak series of failures, the famed 17,000 US gallon private display tank of super-rich American hobbyist Andrew Sandler (aka PoloReef) suffered major damage to coral and fish stock after rumoured faulty valves drained thousands of gallons from the tank.

With the battle over Hawaii's aquarium fishing industry at a critical point, renowned aquaculture operation Biota courted controversy by adopting a stance that supports legislation prohibiting the commercial harvest of wild fish in Hawaii. Critics claimed it as evidence the company is trying to use environmental policy to create a monopoly.

Following a change in opinion from the Joint Nature Conservation Committee (JNCC), the coral species *Acanthophyllia deshayesiana* and *Trachyphyllia geoffroyi* are now considered legal for export to the UK from Indonesia. The JNCC reviewed its findings and determined that a positive "non-detriment" finding can be made, reversing a previous negative opinion.

Acanthophyllia deshayesiana - image J Clipperton

To keep up with the latest developments in 'real time', don't forget to **follow our social media channels** where we bring you the latest reef news and discoveries as they happen!

Cresco Ltd Acquires D-D The Aquarium Solution, Solidifying Global Leadership

Cresco Ltd, a UK-based investment company, today announced the acquisition of D-D The Aquarium Solution ("D-D"), a leading and highly respected brand in the marine aquarium industry. This transaction underscores Cresco's strategic commitment to expanding its footprint in the marine and aquatic sector.

This key acquisition significantly strengthens Cresco's presence in the global marine aquarium market, where it also owns Red Sea, a globally recognized leader in premium aquatic solutions. While D-D and Red Sea will continue to operate as independent brands, the newly formed partnership is expected to generate strategic advantages across their combined supply chains, enhancing operational efficiencies and delivering greater value to retailers and distributors worldwide.

Mr. David Saxby, founder of D-D, will retain a key role; ensuring the brand's vision and ethos remains true to its heritage.

"Joining forces with Cresco marks an exciting new chapter for D-D," said David Saxby. "With Cresco's support, D-D will be better positioned than ever to expand its capabilities while staying true to the values of quality and innovation that define the brand."

This merger is a clear signal of Cresco's ambition to be a dominant force, offering a comprehensive and diverse portfolio of solutions for marine aquarium enthusiasts globally.

About D-D The Aquarium Solutions

Founded over 20 years ago by David Saxby, D-D is a leading brand in the marine aquarium industry. It is globally recognised for its commitment to quality, innovative products, and exceptional customer satisfaction, making it a trusted name among hobbyists and professionals worldwide.

About Cresco Ltd

Cresco Ltd is a UK-based investment company with a focus on strategic growth and value creation. The acquisition of D-D The Aquarium Solution, alongside its ownership of Red Sea, highlights its focused investment strategy within the dynamic marine and aquatic sector.

When You Need A Serious Pump, Reach For D-D's New Funktion "Pro 30"

The Funktion Pro 30 multi-function pump is the latest in the range from D-D and designed for the larger aquarium, or commercial applications, with an impressive maximum flow rate of 30,000 L/H and a maximum head of 10M.

It is a professional multi-function pump with unique digital controller featuring 3 wave functions and a constant flow mode, as found in its smaller cousins from the standard Funktion Pump range, giving the ability for it to be used as a return pump or wavemaker on a closed loop.

Durable components such as titanium, silicon carbide ceramic bearings and a reinforced plastic housings make the pump ideal for use externally mounted in demanding situations but can also be fully submerged in a sump as it is 100% waterproof. The pump has a 10M cable between the controller and pump motor allowing remote positioning for easy access to change the settings or monitor the pumps operation on the LCD screen.

Unions and fittings are included to allow connection to 50mm or 62mm rigid PVC aquarium plumbing if needed. Alternatively connections can be made directly to the 2" BSP thread on the inlet and outlet.

Safe for salt or freshwater use, the sine wave technology and low voltage motor offers ultra-low running noise, low heat output and energy efficiency.

"Durable components such as titanium, silicon carbide ceramic bearings and a reinforced plastic housings make the pump ideal for use externally mounted in demanding situations"

www.theaquariumsolution.com

Shop Visit: Advanced Aquarium Consultancy (AAC) Ltd - Harlow, Essex

In case you haven't guessed it already, this issue saw me on yet another "reefing road trip" as this time I journeyed around 4 hours South to good ol' London town. Just like back in April 2022 (issue 93), this jaunt involved a visit to the legendary display tank of David Saxby, a superb dinner with David afterwards, an overnight hotel stay (and obligatory full breakfast buffet), and then a visit to one of the very best reef shops in the UK. Not too shabby!

It wasn't all roses though as, after a long drive and an intense 4-hour tank shoot at David's central London flat, I then had to negotiate another hour long drive out from central London at 9pm which let's say was quite an "exciting" experience (for a simple Cheshire boy like me anyway). Thank God (or should that be Google) for navigation apps as I think I'd still be trying to find my way out otherwise! As with David's tank, it's been 4 years since my last shop feature on AAC (although I have been there a couple of times in the interim to attend events such as Love2Reef and "Reefing Audience Live" events). Having kept a close eye on their social media channels though, I know there have been plenty of developments - so let's dive right in and catch-up with owners Paul and Angela Hughes, and the rest of the AAC Team!

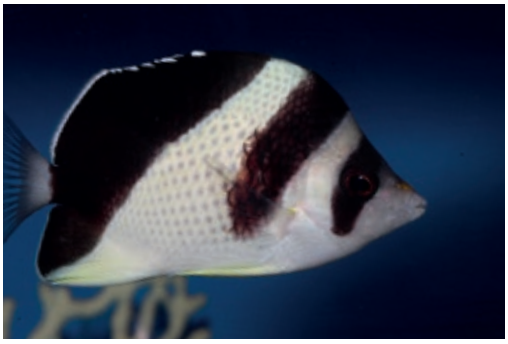
While I'd normally dedicate the majority of a feature like this to walking you through a shop to give a first-person perspective, I'm only going to do this for part of this article as a) I am (as always) pressed for space, and b) there are other aspects to this visit that I think are equally, if not more, important to cover. I am aware that not all of my readers will be familiar with

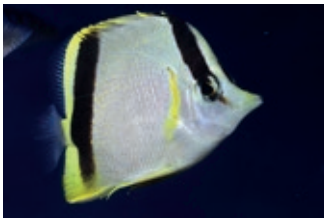
"the shop extends away with more coral trays, large expanses of dry goods and a long counter."

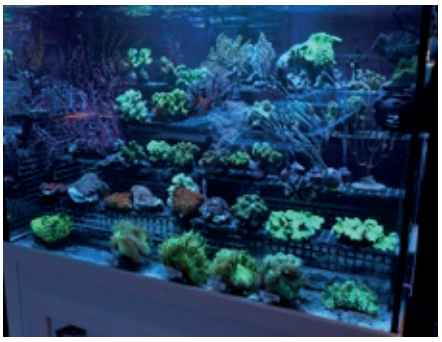
AAC at all though, nor have read my last report, so for the many of you who I know have joined the magazine after my last visit, take note that, for starters, Essex-based AAC is in a great location. The M11 is just 1.5 miles to the East and Northern part of the M25 just 5 miles or so to the South – so no faffing around on minor roads. Entering the store, you will immediately see that the main shop space is very large. While a three-tier bank of fish tanks stretches away on the immediate left into the far rear corner of the store, there are an array of display tanks (both dry and running), corals trays and a bagging area in the centre. To the right, the shop extends away with more coral trays, large expanses of dry goods and a long counter. Walking around the store in a broadly clockwise direction, the afore-mentioned fish system here (on your left) really is top notch. There's a great spread of species both common

and rare, tank-bred and wild, large and small, and prices are very reasonable. Plenty of individual fish caught my eye and these included a gorgeous Kuiter's wrasse, a Multicolor angel, a Marcella butterfly and a group of captive-bred, juvenile *Cheilodipterus quinquelineatus* cardinalfishes, all looking in rude health. Continuing around a slight dog-leg in the tanks, there are banks dedicated to clean-up crew such as snails, urchins, crabs and shrimps, plus plenty of anemones, pipefishes and some mandarins (plus all kinds of other critters). There was also a gorgeous *Acanthurus polyzona* tang in one of the top levels tanks priced at £699 which is a great price for such a rare fish! As I walk through this section, there are also large coral trays on my right, each containing long, serried ranks of brightly fluorescent coral of all kinds. One of these tanks contained some especially nice "showstopper" *Symphyllia*, although these are way out of my price range! Continuing around the rear of the store, AAC's largest display tank (a Deltec Trendline Panorama 1500ltr) hoves into view. It's as-impressive-a-reef-system as you are ever going to see, perhaps to be expected at this specialist store! Filled with a selection of reef rarities this tank really is a genuine sight to behold and truly something to aspire to (I featured this tank back in issue 94 if you want to read about how it runs etc). Pressing on, I turn a corner and there's a very nice bare-bottom Red Sea Peninsula 500 reefer filled with huge soft corals that mesmerise with a swaying motion provided by a discreetly hidden Tunze wavebox. Next is a blue-hued coral holding tank, the several egg crate shelves each holding a range of fluorescent LPS, soft corals, zoas plus some lovely gorgonians and sea fans. New

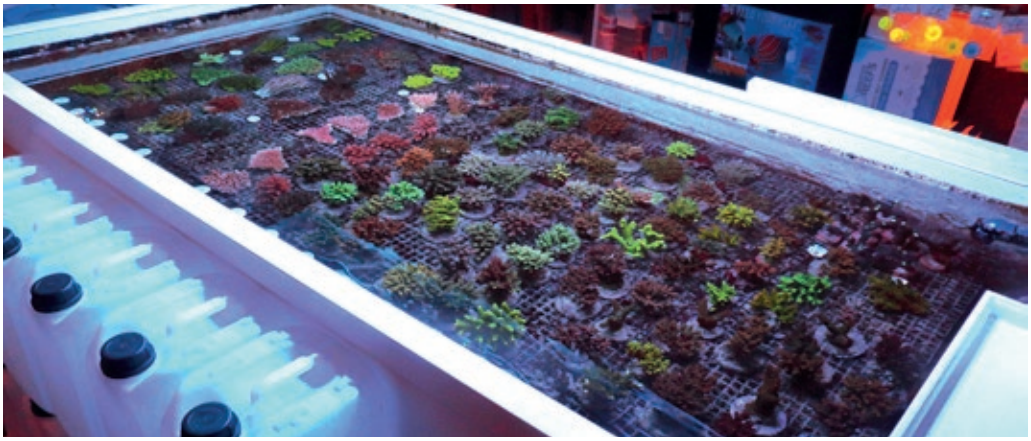
As usual there was a great selection of marine fish on my visit. AAC offers one of the best selections in the UK.

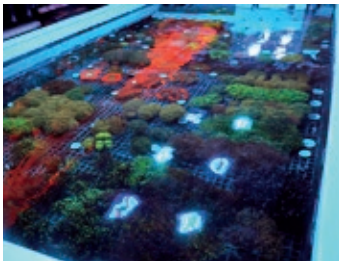


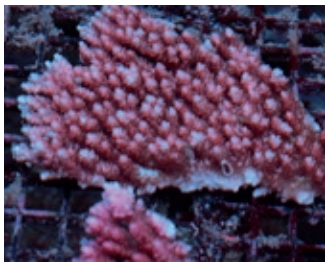




Above: There are multiple display tanks on show at AAC, some of the best in the UK. Below: A selection of the coral trays which include SPS, LPS and soft corals of all kinds. There were far too many to mention specifically but I must say the SPS tray was particularly impressive. A gorgeous pink tabling Acropora was hard to miss.







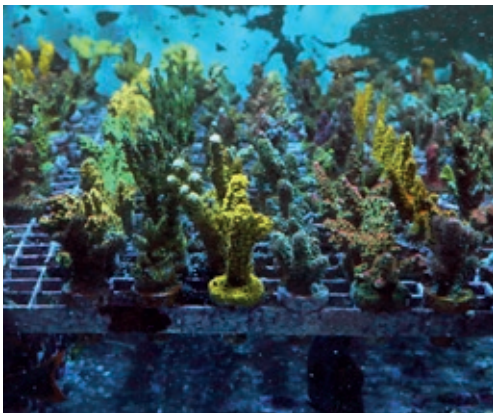
to me on this visit, there's also now a fabulous NPS display/ sale tank on the corner here. A testament to the exceptional skills and commitment of the team, the delicate corals in this tank require almost constant feeding and massive water changes. There are some species in this tank that are slightly less demanding though, particularly there were several lovely *Paraminabea rubeusa* specimens which I'm told are essentially "easy chilli corals". There were also some famed Koji Wada Pink *Nephthea* frags one of which I couldn't help bringing home with me! (this is typical of the unique corals you will find at AAC, and nowhere

else!).
Now opposite the long main counter, a central island consisting of two large coral trays extends to the far wall of the store. Bedecked in glossy white fibreglass for a super clean and modern look, and adorned in EcoTech livery, these trays look like they've come straight out of the USA factory but infact were designed by the store. They hold larger LPS specimens and dozens of maricultured SPS colonies, virtually all of which are wallet-twitchingly fantastic. Standouts for me here was just the sheer number and choice of SPS colonies, plus some standout pieces in the LPS tray such as a group of large *Plerogyra* bubble corals in various shades.

While the above is already enough to make AAC worth a visit, this is just one of the 4 units that the shop now comprises. With the main shop based in Units 6 and 7, the AAC Coralab Is based in Unit 4. This now well-established, cutting-edge aquaculture facility is where Paul maintains what amounts to a precious vault of legacy corals (plus many of the latest strains too). As an example, he has a whole tray dedicated to torches and hammer corals lest ever shifting legislation results in their legal import being impacted. In this case, thanks to Paul, a sustainable supply should remain available to UK hobbyists (as he did when the 2018-2020 Indonesian ban was in place). The facility is as amazing as the last time I visited, and this was all the more surprising given that it suffered a major setback last year due to some pipe repairs in the area by the local water company. In a series of freak mishaps, this resulted in the insidious injection of Chloramine into the systems, which (by the time it had been unmasked as the culprit), had already damaged many of the corals (take note of this for your own tanks folks!). Moving on, part of this facility is also dedicated to nursing any fish that are in anything other than top condition back to health, which is great to see.

Another new development on this visit, and a major one at that, is based in Unit 5 where there is now a fully functional seahorse farm! Almost on par with a hospital or veterinary ward, this facility is once again cutting-edge stuff and clearly the most detailed thought has been put into its design. Paul showed me a large bank of tanks with the seahorse species *Hippocampus erectus* at various stages of development, from several weeks down to 1 week old. Run as a dedicated system, strict protocols are in place to ensure hygiene and pathogen control in this space, with broodstock being maintained in a separate, dedicated system. It was great to see Paul interact with one gorgeous yellow female seahorse who he has named "Sunglasses" (due to black band around the eye area) who clearly recognised him! In addition to *H. erectus*, Paul also breeds dwarf seahorses *H. zosterae* in this facility and it was fascinating to see broodstock with tiny babies. Paul recently shared a video on social media showing a simple seahorse set-up that AAC are now selling, which is ideal for keeping this species. He's even having realistic plastic macroalgaes made to incorporate into both these tanks and his wider fish systems as they are ideal for providing naturalistic cover (in quarantine tanks also). These are now available for sale in-store and online. Before we leave this area, finally, it was great to see AAC's livestreaming studio in person. If you haven't tuned in to any of these broadcasts yet, I highly recommend that you do, as they are always a great source of news and entertainment. It's also a great way to interact with both the team and other reef-keepers.

I mentioned at the beginning of this piece that I wanted to cover more than just my regular shop walkaround this time and after having a long



Despite suffering a setback, the AAC Coralab is still an incredible facility. Paul uses this as a "library" of corals in case of disruptions to supply for example. This area also contains a system for quarantining and conditioning fish.

This is the first time I've seen the AAC seahorse farm and I must say it looks incredible... so clean and well-organised. This new area is also where the AAC Livestream study is based (Paul is seen getting ready for a stream that night), plus there are some phenomenal coral trays in here each one controlled by a Neptune Trident.

chat to Paul, there's clearly more than just the shop that makes AAC unique in the UK reef-keeping scene today.

To sum this up neatly is a tricky task, but overall I believe it is Paul's long involvement at a high level in the trade that is at the heart of what puts AAC on such a different level to most UK stores.

Having lived the trade for decades, Paul still evidently retains his deep love for the hobby, but this is tempered by a now seasoned and pragmatic approach that is sadly lacking in some of the new on-the-block shops nowadays.

Looking forward, he is acutely aware of the threats that face the hobby today, particularly from lobby groups that seek to ban all kinds of exotic pets. It is for this reason he is particularly vocal about corals that have entered the UK trade via dubious routes… as such activities give opponents of the hobby the perfect weaponry to justify their stance. The sad fact is that, while sustainable reef-keeping certainly can benefit all parties concerned, there are agents within the UK trade that still unscrupulously put profit ahead of such concerns. To this end, Paul is pushing for a return to what he terms "full spectrum reefing" where as a hobby we move away from the US-led penchant for heavily blue hued tanks which showcase only the most gaudy fluorescent species (which are often those very species that are the subject of "creative import practices"). As someone who can remember the days of 10k metal halides and the like, I echo this sentiment (personally I find it impossible to appreciate the colouration of most reef fish species in such tanks anyway). As Paul is keen to remind, there are plenty of easily obtainable coral species that hobbyists are missing out on with the current obsession with predominantly blue hued reef lighting. For a start, the colour of some of the most beautiful SPS species are best appreciated (and fostered) under full spectrum lighting. Put simply, we really need to move away from the "trophy bagging" approach that seems to be prevalent today, especially when it is done with no regard for the sustainability of wild stocks of the coral species in question, or the long-term viability of the UK hobby. Paul's home tank is far more impressive to me personally than many of the Instagram tanks we are seeing at the moment… and the corals in it are not several hundred pounds apiece (I'm actively trying to persuade him to put a feature together on it for a coming issue). I'm not saying that I don't like blue lighting here by the way, but both it and the corals it showcases, shouldn't be the "be all, end all" of reefing.

Shifting slightly, Paul tempers his views with a change of perspective from looking into the future and instead looking into the past as he has worked with some of the pioneers of the UK reef-keeping hobby… elders of the hobby such as Terry Evans of legendary store "WetPets" (who Paul calls the

Grandfather of the modern UK reef-keeping scene) and Barry Jackson of Home Marine, who passed on his premium level of knowledge and handling to Paul. We really are lucky to have had such founders here in the UK and let's appreciate how their work (and many others who I've not named) have got us to where we are today. Let's just hope we don't "blow it" after we've come so far!

Given our discussion I think it's fitting to give Paul the last word in this piece. Before I do though, I'd like to express my gratitude for being allowed once again to roam the AAC facility "at will", and for the friendly reception and generosity of Ange and the rest of the team during my visit. I sincerely hope to visit again soon, perhaps if AAC decide to run any more special hobby events. Who knows, if it's another 4 years before I visit Paul and Ange, they may be basking on a beach somewhere, while the next generation takes the reins at AAC HQ!

Finally, in closing, I invited Paul to communicate, in his own words, a message to you, the UltraMarine reader, as the UK hobby continues to navigate turbulent waters. So what can we do as individual hobbyists to ensure we don't just keep afloat, but stay on a steady course into the future of reef-keeping in the UK?

Above: Exlusively availabel at AAC... new realistic artificial macro algaes for seahorse, fish only, quarantine tanks etc. Above right- a tiny *Hippocampus zosterae* peers at my while hitched onto some of the new macroalgae. Below: Ange deals with another customer.

Paul explains, *"When John first asked me to provide a closing comment for this article, I wasn't entirely sure how to put my thoughts into words. On reflection, though, I believe it's vital that readers of Ultramarine—and the wider reefing community—recognise that we are now facing increasingly turbulent times when it comes to the future of this hobby as we know it.*

That reality is exactly why I feel so strongly about the way we approach the animals in our care. Whether you're a dealer or a hobbyist, the choices we make around sourcing, husbandry, and sustainability truly matter. Good practice is no longer something optional, as it may once have been—it is now a fundamental responsibility we all share.

So next time you're in your local fish store, or about to press "buy" on an online coral or fish purchase, take a moment to really consider the animal in front of you. Are you choosing it simply because it's on trend, or to keep up appearances? When it comes to coral, is it just another "trophy" piece to add to a collection, or are you genuinely interested in its long-term biological needs? Are you prepared to research and provide the conditions required for its ongoing health and survival?

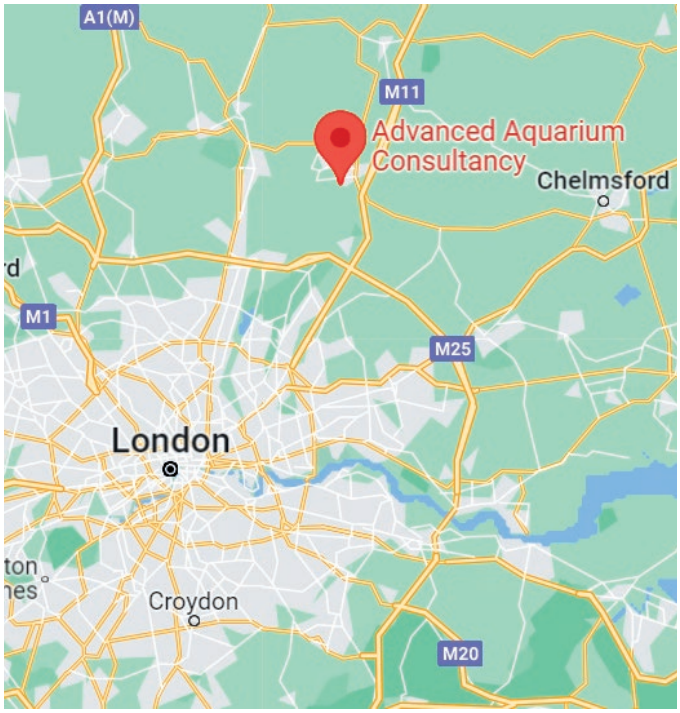
It's also worth reflecting on the environments we create in captivity. For example, are our lighting choices truly appropriate? Is a heavy reliance on royal blue spectrum something that reflects what these animals experience in the wild, or are we prioritising aesthetics over welfare?

We can no longer afford to make avoidable mistakes based on poor decisions—especially when it comes to

fish. As a community, we must demonstrate that we are capable of caring for these animals responsibly, with respect and understanding, rather than being compared to the collectors and trophy hunters of the past.

Finally, let's not hand ammunition to those who already view this hobby as destructive or driven by unethical practices. If you are aware that an animal has been sourced illegally or imported under questionable conditions, don't support it. If you truly value this hobby and want to see it continue, then it's on all of us to make informed, ethical choices that protect both the animals and the future of reef-keeping itself.

The AAC Team present during my visit - from left to right, Barry Young, Dylan and Connor Hughes, Kianna Chapman, and Angela and Paul Hughes.



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Elacatinus evelynae - image J Clipperton

We all love our lethal lionfish, temperamental tangs and touchy triggerfish, but how about going a little… smaller? **Marijke Puts** talks neon gobies, your new favourite fish for desktop aquariums and peaceful larger reefs alike.

Reef Icons

No.43

By Marijke Puts
(images as credited)

Marijke set up her first aquarium when she was just 13 years old and hasn't looked back since. Today, she's a pop science writer specialising in marine biology and fishkeeping (fresh + saltwater). She is also an avid scuba diver and underwater photographer, and proud owner of a 30-litre reef cube. Originally from the Netherlands but now living in sunny Spain, she spends her summers submerged in the Mediterranean and her winters searching for fossils in the mountains. Read more about Marijke at: **ultramarinemagazine.co.uk/contributors**

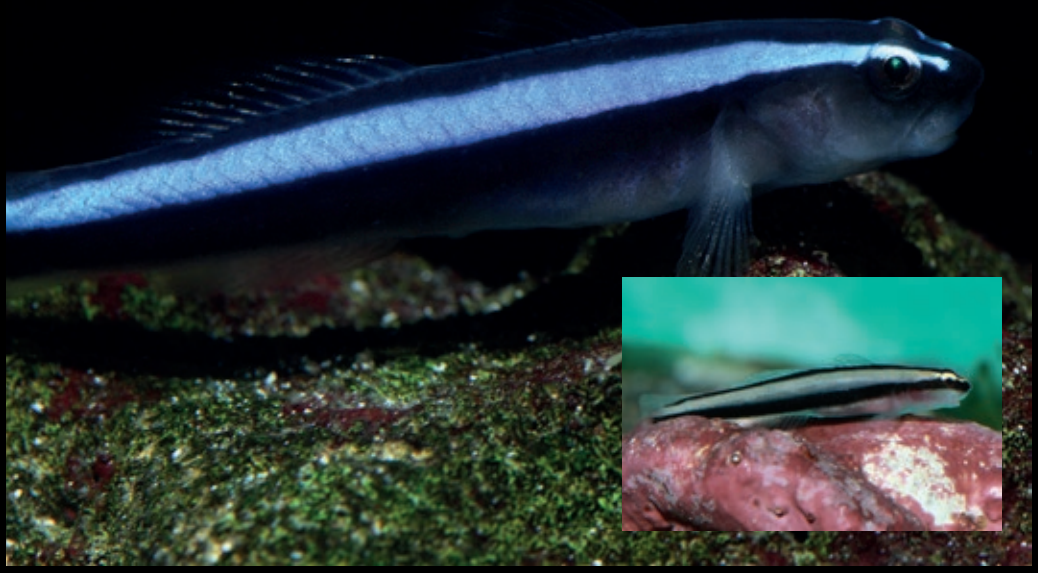
Meet the neon gobies

When I spotted my first ever neon goby, I was ten metres below the surface, hovering over a Caribbean reef (an excellent place to be). My attention was initially drawn by a spectacular brain coral, more formally known as *Colpophyllia natans*, but I was quickly distracted by the tiny, colourful fish using the coral's folds as its own personal lounger. Tiny, stationary, and brightly coloured? I figured I must be dealing with a species present in the aquarium hobby, a hunch quickly confirmed when I ID'd it as *Elacatinus evelynae*: the sharknose goby. Mine was perched on that coral boulder waiting for parasite-ridden fish to turn up for a 'car wash', and I probably disappointed it by refusing to open my mouth.

Elacatinus evelynae - image by Marijke Puts

The scene painted here feels perfectly Caribbean: brain coral, sweet little cleaner goby. But that's only because the Caribbean itself is a relatively recent invention. Aquarists tend to view neon gobies like the sharknose as strictly Western Atlantic fish, but I was fascinated to find this to be not quite true. Scientists have shown that when the Isthmus of Panama closed around three million years ago, the genus was present on both side of what was—until then—a single pond. Some species got 'trapped' in the Eastern Pacific when it became fully separated from the Atlantic Ocean, and they were far from alone: the separation of these two oceans is one of the most significant geological events in 'recent' evolutionary history. The *Elacatinus* we keep in our aquariums just happen to be the ones that ended up on the Caribbean side. Their Pacific cousins would probably adapt to captive life just fine, too, but we've never heard of them because they simply aren't exported on a regular basis.

If you noted how the pretty blue stripe many neon gobies sport makes them look a little like shrunken cleaner wrasses, you were onto something. On the reef, horizontal stripes are a hallmark sign of cleaning species. Blue striping in particular is as conspicuous as a 'WE BUY GOLD'-sign on the high street, except they signal something closer to 'WE EAT ECTOPARASITES'. Instead of quickly gulping the tiny goby down, most predatory fish assume a special cleaning position and enjoy their spa treatment. Green and yellow-striped gobies also act as cleaners, but the riskiest clients are more often handled by their blue counterparts. Thanks to its cleaning capabilities, even a tiny and vulnerable fish like the neon goby can survive on the reef!



Elacatinus oceanops - the Neon Goby. The classic species easily identified by the solid blue neon stripe. Inset - *E. figaro*, with pale or yellow stripes. Images by J Clipperton

Neon gobies in the aquarium
To neon, or not to neon?

If you've ever tried to keep the quintessential cleaner fish, the bluestreak cleaner wrasse, the experience might have caused you to permanently steer clear of all cleaner species. They often starve in our aquariums—not really a fun experience, and they probably shouldn't be offered for sale at all. But there's no need to also avoid neon gobies, which don't stick to their principles the way their wrasse counterparts do. The gobies don't rely exclusively on their clients in the wild, and they're perfectly able to recognise food that's not attached to another fish, thank you very much. This makes them excellent eaters that will tuck into pellets or frozen foods with gusto.

But what about lifespan? You may have heard these gobies are short-lived, and unfortunately that part is not a myth. The species that don't clean for a living tend to have a bit of time, but cleaner fish in general are known for their short lifespans. Consider: wild neon gobies experience high natural turnover due to their risky lifestyles—cleaning predatory fish, venturing out into the open on the reef. As a result, evolution favours fast lives over young ones. At least they stick around longer than the Indo-Pacific *Eviota* gobies, some of which take 'live fast, die young' to a whole other level by completing their entire life cycle in a single season!

So we've got a fish that eats like a champ but will probably kick the bucket before reaching its second birthday. Worth it? Given that you should be able to buy various species of tank-bred neon gobies for around £30, I think yes. Their tiny size, tiny bioload, and huge site fidelity (they're total homebodies that maintain very limited territories) make them one of the best fish for a desktop tank. Although that's not to say they can't thrive in larger reefs, too!

Elacatinus multifasciatus - Image by J Clipperton

Elacatinus puncticulatus - t Image by J Clipperton

Aquarium care
Set-up

If you're thinking of going ahead with that *Elacatinus* desktop tank, keep in mind that if they're going to thrive, they'll need a system adapted to their specific needs. For a single pair, that would mean a mature reef-style set-up of at least 40 litres. Plenty of live rock, including both perches and crevices, is a must (as is a lid, because most reef fish go airborne when startled).

Neon gobies often use corals as perches in the wild, and you can offer them some in your aquarium too. They're not known to be nippers and their bodies are very light, meaning they're unlikely to irritate your prized and expensive polyps by lounging on them. It's just too bad *Colpophyllia natans*, the brain coral some wild neon gobies like to use as their cleaning stations, is such a hassle to grow at home! Still, anything that offers a textured, elevated sitting surface should work. You can try gorgonians, *Favia*, or maybe even something like *Lobophyllia*.

Tankmates

In a desktop tank, there is really no space for a community in the traditional sense, and I wouldn't personally try my luck with other fish at all (but I'd certainly add some fun invertebrates). That changes in a larger reef setting, although any tankmates should still be small and inoffensive because the 'armour' afforded by these gobies' cleaner status doesn't quite hold up in captivity. On the open reef, after all, fish visit a goby cleaning station, receive their mani-pedi, and then leave. That doesn't happen in the aquarium. Common clients like damselfish will turn into their cleaners' bullies if they can't be evicted after treatment!
Best to opt for inoffensive species that aren't known for harassing their neighbours. This still gives you a wide range of options, including blennies, dartfish, chromis, wrasses (flasher or fairy), and basslets. Even large Caribbean tangs and surgeonfish could work in the right set-up, because unlike damselfish, they typically show excellent etiquette where cleaner fish are concerned. Don't rule out other gobies either! For multiple neon goby pairs, you'd have to carefully ensure each of them has at least 40 centimetres of tank footprint to work with to prevent your aquarium project from devolving into WWIII. But if you just want something like a watchman, that's fine—they occupy a completely different niche and are too different for the neons to view them as competition. The same goes for the dwarfgobies of the genera *Trimma* and *Eviota*, which are similar in size but have different lifestyles. Many of these potential tankmates will be interested to some degree in receiving cleaning services, so there's a good chance you'll get to observe this fascinating behaviour right in your home aquarium.

Feeding multiple times a day is a must for cleaner species, as their fast metabolisms burn energy quickly. You can offer standard prepared carnivore foods and frozen fare, but your best bet for keeping those gobies truly fat and happy is to use a second tank (or refugium) to grow lots of tasty pods. This is also why I mentioned your set-up should be mature before you introduce the neons: a steady stream of microcrustacean snacks between meals goes a long way in keeping your gobies in tip-top condition.

Conclusion

I'll be the first to admit that neon gobies won't draw people's eyes to your reef the way a butterflyfish or trigger does, and they certainly won't live long enough to start feeling like old friends. But size isn't all, and the gobies are wonderfully unproblematic—not to mention fascinating.

No matter how many times you see a fish cleaning its tankmates, getting to experience a piece of reef ecology playing out in your own home is priceless.

A former member of the *Elacatnus* genus, *Tigrigobius macrodon* (commonly known as the Tiger Goby) is a fascinating little fish, similar in care requirements. Image by J Clipperton

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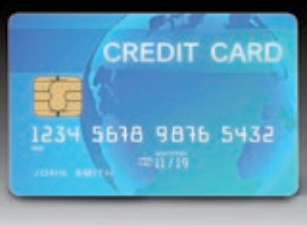

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A Matter Of Opinion

Advice and opinion for hobbyists from a representative of the trade

with guest, Sapphire Littler

Nitrate and phosphate in the marine aquarium are two of the most important parameters we should be controlling.

Sapphire has been a keen aquarist for twenty years, and has never been without an aquarium since the age of eight. Starting work in the freshwater aquatics industry in 2017, she took the plunge and set up her first reef tank in 2019. Ever since, she's been a true convert and now works at Yorkshire Reefs. Taking inspiration from her background in planted aquaria, she enjoys the creativity behind designing stunning underwater ecosystems, and has been known to spend multiple days creating the perfect rockwork. She spends her days selling fish and corals, fragging, and testing water, but her evenings are spent working on her PhD in classical music.

But they also seem to be two of the most controversial parameters: with several different trains of thought; and each school thinking they're correct. The following article discusses my *own opinion* on where they should be, what effects we see when they aren't where we'd like them to be, and how they can be controlled.

Testing nitrate & phosphate

Before getting into the nitty gritty of numbers, we need to make sure the numbers we're working with can be trusted. Test kits seem to vary wildly in accuracy, and when we're working with parameters like phosphate - which are small numbers we are testing in parts per *million* - we need to be using test kits which are accurate to a very small degree. Anything with a margin of error of 0.05ppm or more is not going to be reliable enough.

The only testing device I've found which is accurate for phosphate is the **Hanna Phosphate Ultra Low Range Checker** - it's accurate to 0.02ppm, and I've found them to give results which are usually in-line with ICP tests (it is worth noting that ICP tests consider more forms of phosphate, so the result is often a little higher than any test kit). My personal favourites for nitrate are either **Salifert Nitrate** test kits - which are both cheap and reliable, or the **Hanna High Range Nitrate Checker**, which is more expensive, but provides a numerical result, so no need to be comparing colours.

Then here's a picture of my own tank - taken about six months after corals were added. Notice the lovely white sand, and excellent extension on the goniopora. Nitrate was sitting steady at 11ppm, and phosphate at 0.09ppm.

All about balance

When I first got into reefkeeping almost a decade ago(!) it was trendy to aim for "zero" ppm readings for nitrate and phosphate - a trend which is still affecting how people think today. The difference was, back then it was nigh on impossible to actually hit zero - filtration equipment just wasn't at the same level it is today. Almost everyone was consistently carbon dosing and running phosphate removal media. If people aim for zero now, they tend to *actually hit zero,* which can be disastrous for corals, immediately killing them, and this also often leads to some awful algae blooms.

On a wild reef, there is a constant food source for the corals. Nitrate and phosphate will be consistently low, but they will never usually be zero. The waste from fish is almost

constantly ammonia dosing, which is a fascinating topic in itself (but not one for today). This is hard to replicate in the home aquarium for most, so I find it much easier to run reef tanks with slightly elevated nutrient levels.

Ideal values

One of the most important factors to consider with nitrate and phosphate is how balanced they are. Ideally, I like to see nitrate at a level which is around 100 times higher than phosphate. So if your phosphate is 0.08ppm, nitrates should be at or around 8ppm; if your phosphates are at 0.12ppm, nitrates should be at 12ppm, and so on. I've found that a lot of the time, nutrients that we would consider 'high' don't seem to have much of an effect if they're balanced with each other. As with anything we're testing in a reef tank, stability is key. If your nutrients are wobbling around, we're going to get issues.

In an ideal world, the numbers I've seen have consistently good success for both mixed reef and SPS dominant tanks are nitrates around 10ppm, and phosphates at around 0.1ppm. I do think nutrients can be pushed higher for soft coral dominated tanks, and I've seen some fantastic softie or anemone systems running phosphates as high as 0.3ppm, and nitrates anywhere up to 40ppm.

SPS, however, wouldn't look so great in these conditions - at those kinds of levels you tend to see quite a loss of colour. Have a look at the tank below left and consider what you think the nutrients may be… This is an 800L SPS dominated display we've got at Yorkshire Reefs.

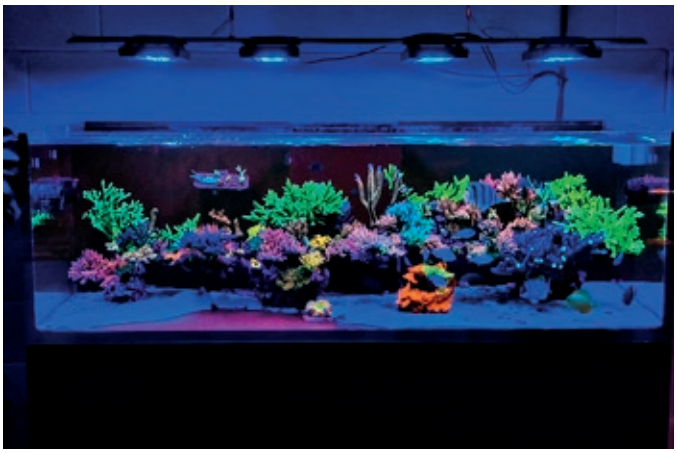
Would it shock you to read that nitrates in this tank are, and have always been, around 15-20ppm, with phosphates between 0.12 and 0.15ppm?

We do tend to see some loss of colour if either nitrates or phosphates creep any higher than this, but up to this level, we get excellent growth, colouration, and polyp extension.

The table opposite lays out my personal opinion on where nutrients should be in different systems. I've come to these conclusions after helping to run hundreds of my customers' reef tanks over the years, and watching how corals respond to different levels.

Every tank is different when it comes to where nitrate and phosphate naturally sit. A lot of it comes down to which strains of bacteria have grown in, but nutrients are also going to be influenced by a multitude of other factors: what fish you keep; how much you feed; the corals you keep; the equipment you run; and so on. What you

Type of system	Lowest nutrient values	Highest nutrient values	Ideal nutrient values
Soft coral/ anemone dominant	0.06ppm phosphate 6ppm nitrate	0.3ppm phosphate 30ppm nitrate	0.15ppm phosphate 15ppm nitrate
LPS dominant	0.05ppm phosphate 5ppm nitrate	0.2ppm phosphate 20ppm nitrate	0.12ppm phosphate 12ppm nitrate
Mixed reef	0.05ppm phosphate 5ppm nitrate	0.2ppm phosphate 20ppm nitrate	0.1ppm phosphate 10ppm nitrate
SPS dominant	0.04ppm phosphate 4ppm nitrate	0.15ppm phosphate 15ppm nitrate	0.08ppm phosphate 8ppm nitrate



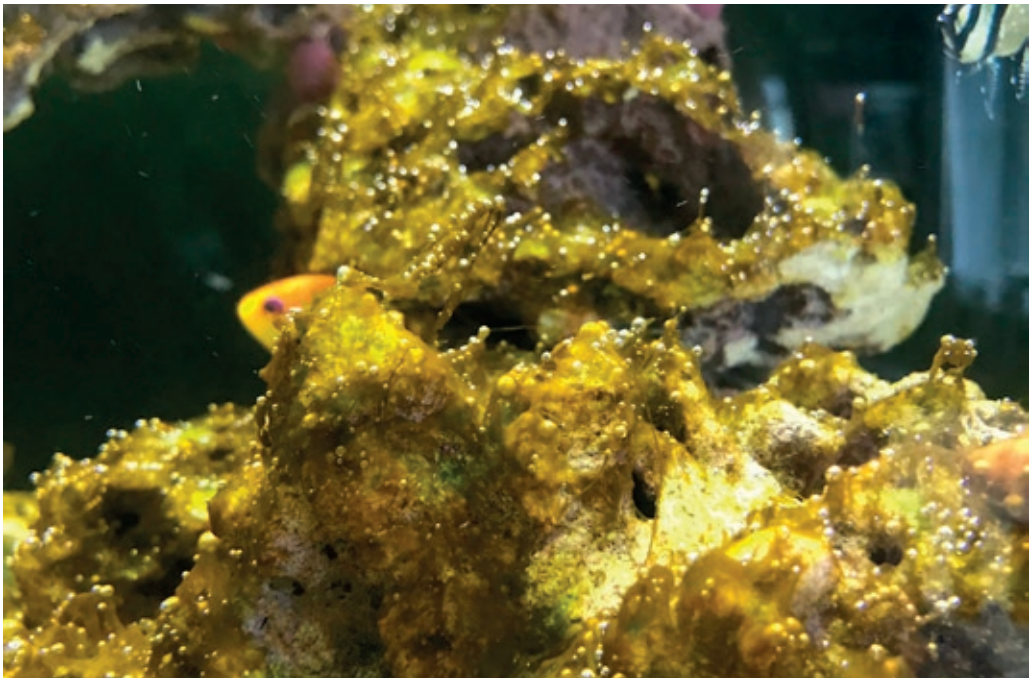
The 800L SPS display at Yorkshire Reefs

can change, though, is how *you personally* manage them.

When nutrient levels are too low

If your nitrate or phosphate levels are consistently testing low - and by this I mean phosphate at or under 0.04ppm, or nitrate under 2ppm, it is feasible that either of them could be dropping to zero at various points in the day or week. There is some natural fluctuation in nutrient levels, especially when we consider feeding times for both fish and corals and lighting changes over the course of 24 hours. It is very common to have issues keeping nitrate and phosphate high in newer reef tanks, and I believe it is fluctuations in nutrient parameters which are already too low which consistently kill corals in newer tanks.

I also think that lower nutrients are what account for 'the ugly stage' in a young reef aquarium - keeping nutrients artificially higher in new systems seems to mean that the ugly stage doesn't happen at all. I followed a modified version of the BRS 'souping method' to cycle my home reef tank, and not only did I completely avoid an ugly stage, but I had corals in from week one (which I still have today!) and I have never struggled with nutrients which bottom out. I went for a more of an 'in-tank souping method', where I didn't run my skimmer or roller filter for almost six weeks, but kept adding fish, bacteria, phytoplankton, and food, whilst maintaining good flow for oxygenation. I pushed my phosphates up to 0.4ppm, and my nitrates to 40ppm, and held them there for almost a month. After that, I turned on my skimmer and roller filter, and the nutrients began to drop, eventually settling with phosphate at 0.1ppm and nitrates at 10. They've very rarely dipped below this, as



These crysophytes (which we identified using a microscope) appeared in a new setup after the phosphate dropped from 0.04ppm to zero in just 24 hours in a customers tank.

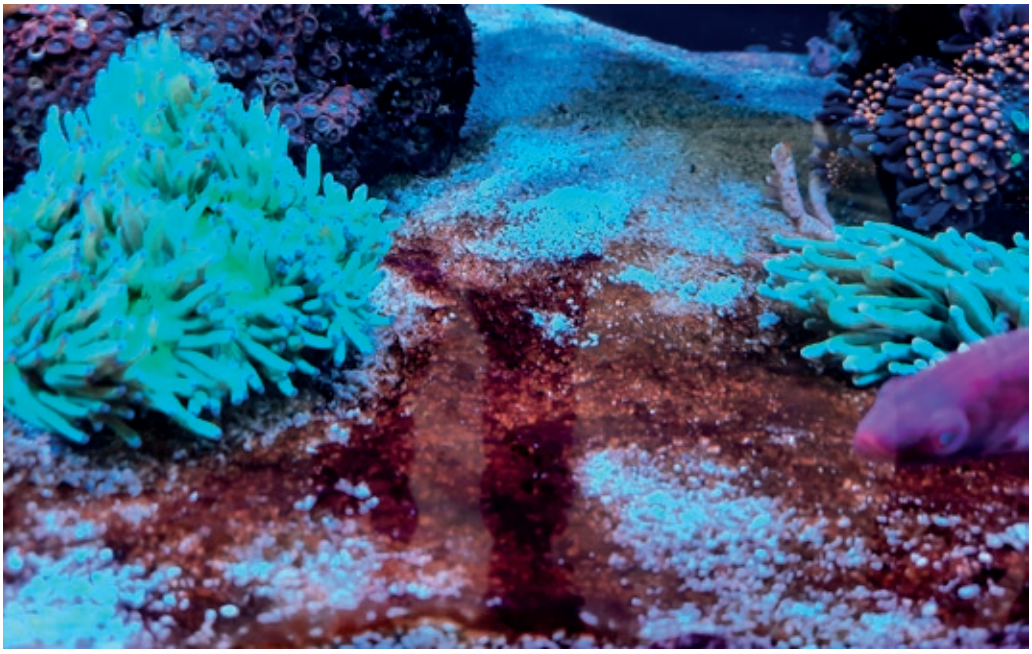
rock 'holds on' to nutrients, and will constantly be leeching these out into the water column if equilibrium isn't the same between the rock and the water.

If you have ever had a problem with cyanobacteria, diatoms, dinoflagellates, or any other nuisance brown or red algae, this is often down to one of your nutrients being too low.

If you've struggled with any kind of filamentous green algaes such as hair algae, bryopsis, or ulva, it is likely your phosphates *were* high. If you tested free phosphate in the water and it is at an ideal value, those phosphates are now locked inside that algae. So as we remove the algae - either manually, or through algae eating fish and invertebrates, we need to keep an eye on phosphate, as it *will* come up, and we need to make sure it's being removed when that happens, or the algae will simply grow right back.

How to control nutrients

If you have consistently **low nitrate *and* phosphate**, the best and easiest way is to



This Cyanobacteria was a recurrent problem for a customer, when the nitrates in his mature system stayed stable at 12ppm, but his phosphates regularly dropped out of balance to 0.04ppm. Increasing the nutrients solved the problem in a matter of weeks.

increase the bioload of your aquarium. More coral food - I like Red Sea Reef Energy AB+ - more fish, and more fish feeding. It's better to feed more times per day than increase the amount of food going in at once.

If just **phosphate is low**, feed more phosphate-heavy coral and fish foods. Polyp Lab Reef-Roids and seaweed is great for this. If that doesn't show an effect over a week or so, it's probably time to start dosing phosphate. There are a couple of options for this on the market - the usuals are the Nyos Phosphate+ or Reef Zlements Z-PhosPlus.

If just **nitrate is low,** you can either dose it to increase it using the Nyos Nitrate+ or Reef Zlements Z-NitroPlus, or, and this is my preferred method, follow the steps for low nitrate and phosphate, and deal with the increase in phosphate via removal media. If you consider yourself somewhat of a scientist, you can also ammonia dose - as ammonia is converted to nitrate - but this will take a bit more research and is a little bit more hands on (and dangerous).

If you have consistently **high nitrate and phosphate,** you first need to work out *why*. Is your tank overstocked? Have you got a bad protein skimmer? Do you need to be doing more regular water changes? And do you have a roller filter? Increase the turnover of water through your sump, the more water you can send through to be filtered the better! Carbon dosing works well, too. Using products like Red Sea NO3PO4-X, Modern Reef C+, or ReefZlements Carbo+ will all feed the bacteria which break down nitrate and phosphate in your aquarium. Couple these with adding some live bacteria weekly, and you should start to see results.

Carbon dosing is a funny thing - to work it needs phosphates above 0.08ppm and nitrates of at least 5. Any lower, and undesirable bacterias will start to grow in (we've all seen a slimy, milky sump from this)! Once we have hit desired levels, it's important to continue carbon dosing, but at a lower amount. Try halving the dose and see what happens.

If just **phosphate is high**, it's an easy fix. Some granular ferric oxide (GFO) from any brand in a reactor will remove it. Change it weekly, and make sure you strip it out *slowly*. Lanthanum-based phosphate removers work very well, but come with their own set of risks. If you decide to go down this route, test phosphate daily, make sure your skimmer is running wetter, and consider mixing lanthanum with RO water and dosing little and often either into a roller filter or skimmer body. Make sure you're regularly ICP testing to keep an eye on lanthanum levels.

Higher nitrates are slightly harder to remove than phosphate - I prefer to carbon dose as well as manually increasing phosphate (through food or dosing), and increase water change amount and/or frequency.

Closing thoughts

I've come to realise over the past few years that when it comes to nutrients, higher is better. The best tanks work as 'heavy in, heavy out' systems - they're aquariums where we're manually adding lots of food, but also working hard to strip that out. Stability is always better than perfect numbers, so if your levels are slightly elevated by don't move much, keep them there. If it ain't broke, don't fix it!

Every tank is wildly different when it comes to where nutrients naturally sit, so remember that *you're in control!* If you want to move a parameter, you can do that - just work on doing that slowly, and then working to maintain it. But my biggest piece of advice is: consider how much more we know about reef-keeping than we did 10-20 years ago. Maybe it's time we all move on from trying to reach absolute zero with our nutrients - it just doesn't work!

This soft coral dominated Red Sea Reefer 300 we've got at Yorkshire Reefs has had phosphates which have sat at 0.25ppm on more than one occasion. When this photo was taken, the phosphates were at around 0.2ppm, with nitrates at about 15ppm.

Capital reef revisited

text and images by John Clipperton

I can't quite believe it's been 4 years since I last visited the iconic reef aquarium of David Saxby. As they say, "time flies when you are having fun", or in my case, it seems to fly whatever I am doing!

For those of you who may have missed my original feature on this system back in issue 93 (April 2022) I highly recommend you read this first as many of the fundamentals of this massive system have remained largely the same in the intervening period.
(I've made it available to read for free on the UltraMarine website by the way).

Given the vast amount I want to cover here I don't want to waste valuable space covering old ground, rather I really wanted this visit to focus not just on how this World renowned system has continued to mature and evolve since my last visit, but also to spend time with Mr Saxby himself and make the most of a rare, personal audience with the "Godfather" of UK reef-keeping in the privacy of his luxurious London home.

Arriving in central London just 2 minutes behind schedule (which I thought was pretty darn good considering my 4-hour drive from the Northwest) David welcomed me in and we immediately sat in his luxurious lounge to enjoy a catch-up over a cup of tea. Over the course of a good hour, it was great to discuss a range of subjects, and I was quite surprised that I didn't feel completely out of my depth with David apart perhaps when it came to more business-related subjects (an area where I've admittedly not a great depth of knowledge). This topic inevitable came up though with, as it is now widely known, David recently deciding to sell D-D (a company he built from nothing around 20 years ago) to Cresco Ltd, an investment company who also own Red Sea. Rather than going into to detail on this here, there's a news article on this earlier in this issue which will give you a little more information. Whatever the case, it was clear that this wasn't an easy nor lightly-made decision for David. Not that it seems to be slowing him down at all, but at 80 years old he makes no excuses that the welfare of his family is at the forefront of his considerations these days, and this is understandable as he had a major health issue that he was either extremely lucky or very tough (or maybe both) to overcome. After some intensive (and at times arduous) treatment, thankfully he is now clear of the stomach cancer that was discovered by chance last year. While definitely a lot more svelte than on my last visit, he genuinely seems to have the same energy, enthusiasm and uncompromising attitude for both his beloved reef, and other aspects of life. Contracted to be involved for at least the next 2 years despite the company sale, thankfully it seems there are no signs of David hanging up the towel just yet, and certainly no plans to end of the astounding reef system that lies at the heart of it all.

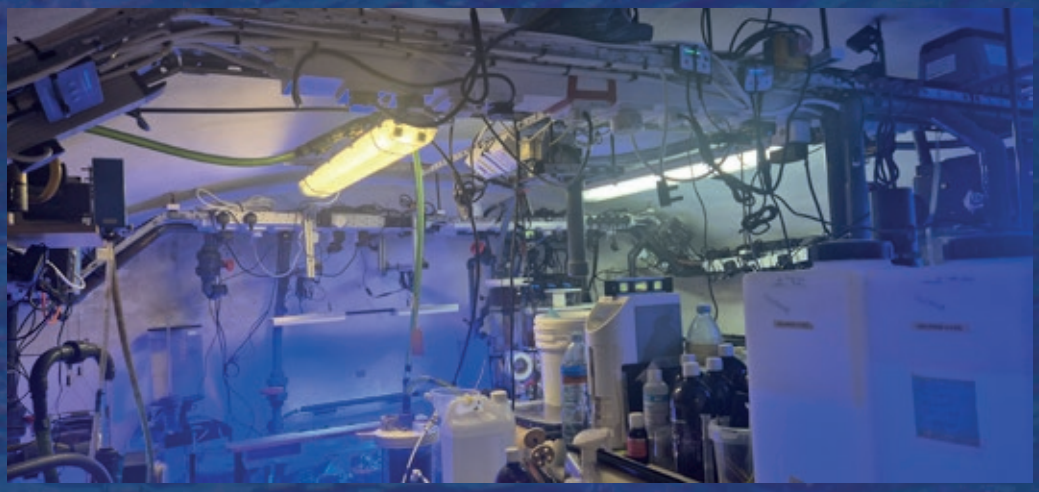
On the subject of this tank, come with me now into David's home as we come face to face with this legendary, behemoth system. Although this tank has had the YouTube treatment more than once, I find none of these have really captured the impact of seeing this tank in the flesh, certainly as I felt it anyway. It really is something that is hard to convey… a literally jaw-dropping, seminal moment for a reef-keeper. The first view of

"Keen to show me the tank from above, David produces a ladder and before I know it, he's up there adjusting this and checking that"

the tank comes after a short corridor, itself enchanting, soft lit and lined with antique ornaments and treasure filled alcoves. At the end of this passageway the first window into this watery world appears on our left, a 4x4 foot square window which dwarves the viewer. In this space a busy community of fish bustle, ranging from huge, inquisitive Surgeonfishes to smaller shier reef species which hurry or dally amongst the throng. I could watch this for scene for hours as "characters" appear then depart for another part of the massive tank, perhaps being replaced by new ones with whom slowly, one begins to become familiar. Where the fish are actors in this scene, the stage itself appears as a living organism, every nook and outcrop encrusted with colourful corals of all kinds, SPS, LPS, soft corals and others. Again, these organisms range from massive pieces to smaller specimens, and this enhances the complexity and diversity of the aquascape. Looking upwards, the underside of the water surface shimmers like a multi-hued mirror, while looking down, there's a large, secret tunnel that passes right through the base of the rockwork to the complete other side of the tank acting as a mysterious subaqueous highway. David tells me that placing corals in the tank is a challenge due to the depth, so he uses a 2-part epoxy to glue corals into place with tongs, then balances a stainless-steel rod on the coral. Left overnight, this rod presses the coral into place until it is set. This area is also where manual feeding of the tank takes place (there are also numerous auto feeds per day). Keen to show me the tank from above, David produces a ladder and before I know it, he's up there adjusting this and checking that (I use this ladder myself later to get some underwater images using my phone… it wasn't easy!).

Continuing left around a corner past this first window, we pass through a set of glass

internal doors into the lounge area. Here, looking left again, the longest side of the tank stretches away to the far wall of the room... and good lord what a vista this is! While the first window seems to be a gathering point for the larger and more boisterous fish (perhaps due to food being added there), this side of the tank is more serene, and a new ensemble of characters comes to the fore. Notably there is a literal cloud of Bluestreak cardinalfishes that shoal tightly as larger fish cruise by… a truly stunning (and rare) sight. There are also many anthias here including, amongst many others, *P. evansi* and *P. ventralis*. Once again, the aquascape is festooned with corals of all kinds… massive *Goniopora* gently wave in the current, while glowing blue and green *Acropora* reach for the surface forming large matrices of intertwined branches. It's a lot



"To replenish calcium and alkalinity, David now uses Reef Zlements H2P dosing system controlled by a D-D KH/PH Manager"

to take in let alone do justice with photography!

As I've already mentioned, the fundamentals of this system are largely unchanged since my last visit which is, in itself, a testament to the thought that went into designing this system. On this subject, this is the third iteration of this tank… the earlier two being redesigned significantly enough to warrant this final version distinct. The tank was mature when I last visited but now, at 10 years old, it looks even better to my eyes. Coral health looks amazing and the only minor issues I can see are evidently the result of corals growing too well and coming into conflict with each other in a constant battle for reef real estate. This is perhaps where the most notable change to the system can be discussed as, where on my last visit David used a huge Deltec TwinTech calcium reactor to replenish minerals, he has now swapped this completely for a new methodology.
To replenish calcium and alkalinity, David now uses Reef Zlements H2P dosing system controlled by a D-D KH/PH Manager. If you aren't familiar with the KH/[H Manager,this clever piece of kit tests alkalinity and pH every few hours and automatically adds (via dosing pumps) just the right amount of Reef Zlements solution to maintain desired levels. In this case, KH is maintained at 7.5dKH while pH is 8.3. Noticing that pH is more elevated and stable than on my last visit I mention this to David and he not only confirms this but also attributes this stability to improved growth rates and coral health. Beyond the KH Manager, regular Reef Zlements ICP tests are an important part of the everyday management of this tank and David is keen to show me his latest reading

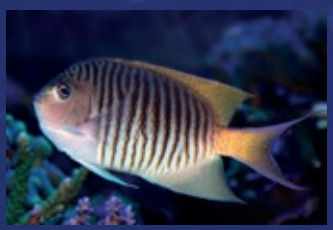
via the RZ ICP app. With everything in the green, it's clear that this system works well indeed pretty much every other element, major or minor is also catered for. While Reef ZIements solutions contain all the necessary elements, David also doses several elements separately using DD dosing pumps. Combined with proper nutrition, it is this tight control and the stability it fosters that has truly taken this tank to the next level in terms of growth, health and colouration.

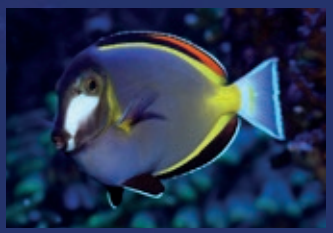
Before I know it, nearly 4 hours have passed and despite this, I feel I've really only scratched the surface of this magnificent reef tank. I could really spend a week here and still find new things to see and photograph (I must add that there was s stunning Borbonius anthias that frustratingly evaded my lens!). However, with time pressing before I needed to head off to my hotel slightly North of central London, we headed off to David's favourite local restaurant (where he is clearly a regular and beloved customer) where I was very generously treated me to a superb dinner and some



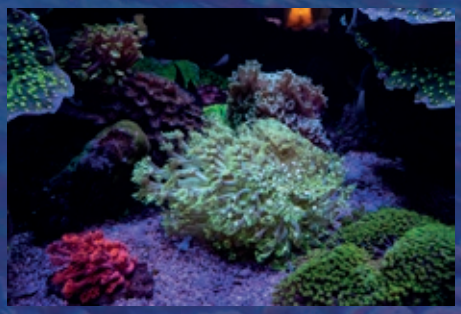
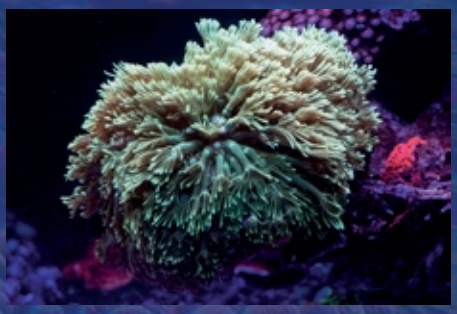



more great conversation. I'd like to say a massive thanks to David and everyone else involved in making this feature possible, and helping me share this iconic UK reef system with my readers. There are lots of great companies involved in UK reef-keeping, but David really has made D-D something unique with his uncompromising direction, hands-on involvement and genuine desire to nurture the hobby (rather than just milk it for profit). I sincerely hope this continues as David passes the baton in the coming years and perhaps time will permit the chance to see David and his fabulous tank again someday.



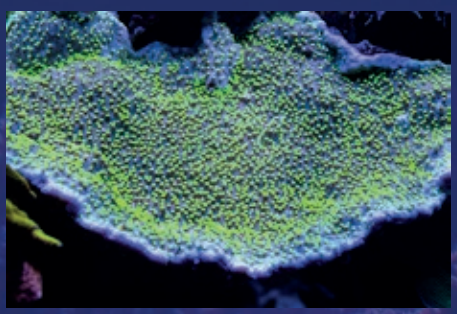
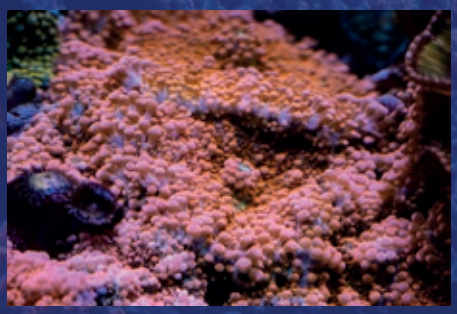


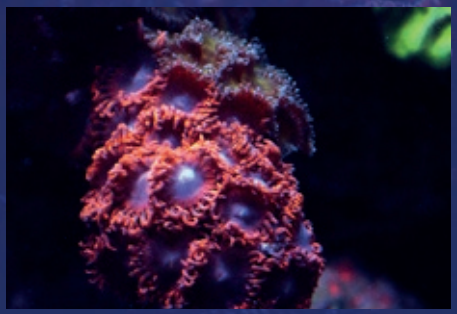


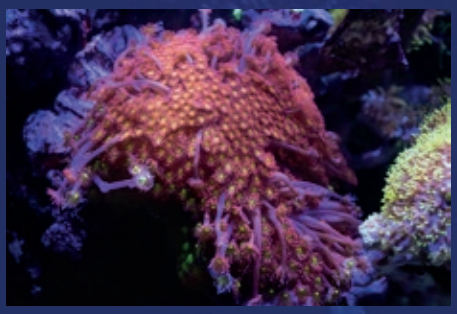










TANK PROFILE - David Saxby

Shape and Dimensions: L shape tank - measures 3 x 2 x 1.5m/10' x 6.6' x 5' and depth is 1.2 m/4', Braced with stainless steel rods

Total Sytem Volume: whole system is around 12'000 litres

Filtration Overview: 3 x Large Deltec Protein Skimmers (one beside the display aquarium and two in the remote sump room), Deltec Fluidised Media Reactors running Rowaphos to control phosphate levels, A large Deltec Nitrate Reactor (sump room), 2 x large Fleece Filter Units (one beside the main aquarium, one in the remote sump room), Large array of U.V Sterilisers (Sump Room)

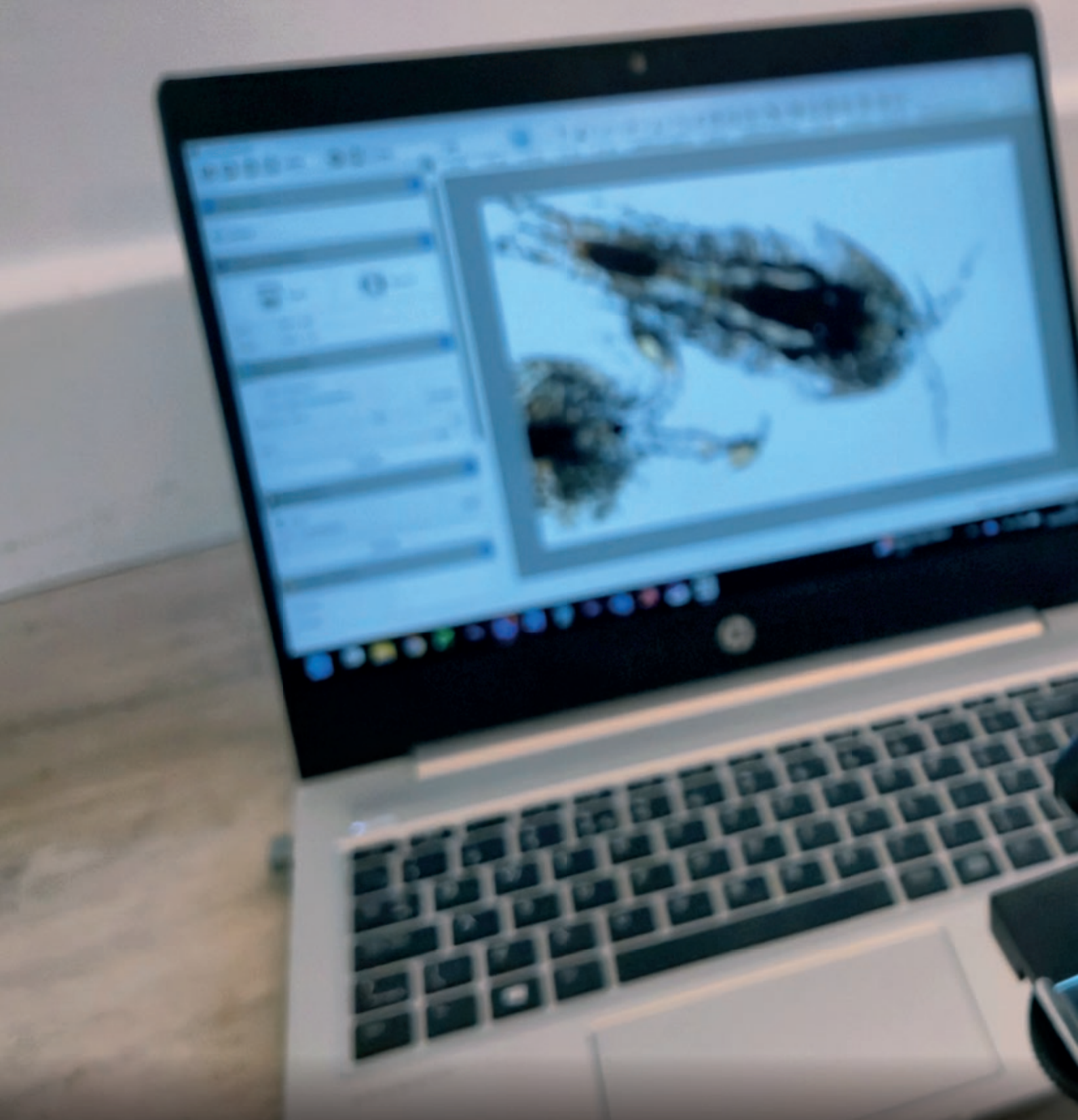
Lighting: Aquaillumination Hydra 52 HD x 19, Aquaillumination Hydra 26 HD x 9

Flow: Multiple Abyzz A400 and A200 pumps supplying a bespoke internal (up and over) closed loop system, pumps are set to create random flow dynamics within the aquarium

Supplementation: Minerals, plus major and minor trace elements are replenished with Reef Zlements products. A KH/PH Manager controls major element dosing, while numerous individual D-D dosing pumps top up other elements depending on regular ICP tests.

Nutrient Control: Nitrate is kept at a level of around 2ppm by the Deltec Nitrate Reactor whilst Phosphate levels are controlled by Rowaphos at a level of 0.018 mg/l

To see images (plus extras) at large size, head to: www.ultramarinemagazine.co.uk



Chances are, if you've been keeping a reef tank for more than a few weeks, you'll have already started to build-up an impressive arsenal of equipment. All aimed at keeping your beloved little slice of ocean clean, pristine, and free from invasive "nasties", this list of equipment can be extensive, encompassing large water treatment items like RO units and protein skimmers at one end, right down to more basic items like algae scrapers, basters and bottled additives, at the other.

Venture into the Microverse

An award-winning photographer and lifelong aquarist, John has worked with numerous top marine retailers, publishers and manufacturers on a freelance basis over the last 20 years. He has also collaborated on a range of projects with experts in the field, and supported organisations such as zoos, public aquaria, conservation initiatives and educational establishments. He has been Editor of UltraMarine since October 2015. Read more about John at: **ultramarinemagazine.co.uk/contributors/**

There's one item I really don't see too many people using though and this is surprising given the cost versus potential usefulness of the item. This bit of kit isn't necessarily just for beginner hobbyists with small tanks either, but also some very large systems with livestock in the hundreds of thousands of pounds could benefit (in fact there's *more* of a case to get hold of one in these cases if anything!). Heck, I've not even used one myself in nearly 25 years of reef-keeping but honestly, now I've actually taken the time to, I'm going to speak out and say it is equally as important as some of the items more well know items mentioned above. Furthermore, I think there's case that this item is even more important in today's hobby where it seems that many tanks suffer outbreaks of mysterious nuisance organisms that are much harder to control than "back in the day" when real ocean rock was more widely used. Enough teasing anyway - the item I'm talking about here is a microscope of course (OK, maybe the title gave it away a bit!).

Crustacea Amphipoda under microscope, Superorder Peracarida. Sample found in White Sea. Image by shoma81 - Adobe Stock

Now, before you start going "glassy-eyed" at the prospect of a physics lecture and an assault of complex optical concepts, rest assured Im going to keep this super simple and focus on what really matters when it comes to using such a piece of kit to back-up your reef tank management. So first of all, let's take an overall look at microscope types and there are really just two kinds that all but the most

Magnification can seem a little complicated at first but it's actually quite simple. Taking the Biolux as an example, this scope has 3 objective lenses (these are the fixed lenses at the base of the unit that rotate into place). These are powered at 4x, 10x and 40x. The scope also comes with two eyepieces at 5x and 16x. These slot into the top tube of the unit and are what you basically look through. In addition, the scope comes with a Barlow tube which can be pulled out of the tube to double the magnification. To calculate the highest magnification, multiply the most powerful objective lens (40x) by the most powerful eyepiece (16x) which gives us 640x. Adding the Barlow tube 2x gives us 1280x maximum magnification.

Slide preparation – for most reef aquarium subjects, water filled or "wet" slides are likely to be your best option. These slides have a slightly concave depression in the centre into which a small droplet of water can be added (with the sample organism included of course). A thin cover slide is carefully lowered over this and any excess water blotted with some tissue paper. At all stages it is important to keep the slides and covers clean by only handling the very edges. Start with a low magnification to get your subject centralised into view and then switch to higher magnification as needed (bear in mind that a live subject may need you to adjust the stage of the microscope to keep it in view)

The Bresser Biolux NV is a compund microscope that comes with everything you need to get started

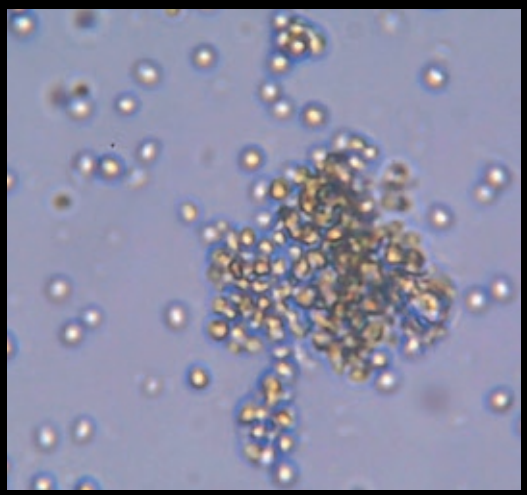
specialised reef-keepers are going to be interested in. The first is the compound microscope. These are designed for high-magnification viewing of mostly thin, transparent specimens such as cells, tissues, blood samples, and perhaps most importantly for us reefers, microorganisms. Using multiple objective lenses to achieve detailed, sharp imaging, they are the standard choice for laboratories, education, medical diagnostics, and research. Compound microscopes do come in a range of different models and varying complexity levels though, from student-friendly 'scopes through to advanced laboratory systems with features such as LED illumination, widefield optics, trinocular heads for camera attachment, and precision focusing for reliable, repeatable results. For most reef-keepers, a budget compound microscope with 40x-1000x magnification should be ideal for identifying common pests like dinoflagellates or diatoms and typically the 40x power is used for targeting samples, and then a more powerful lens can be rotated into place to "move in" closer. Magnifications such as 100x, and 400x are ideal for identifying algae. Sub-stage lighting (where light

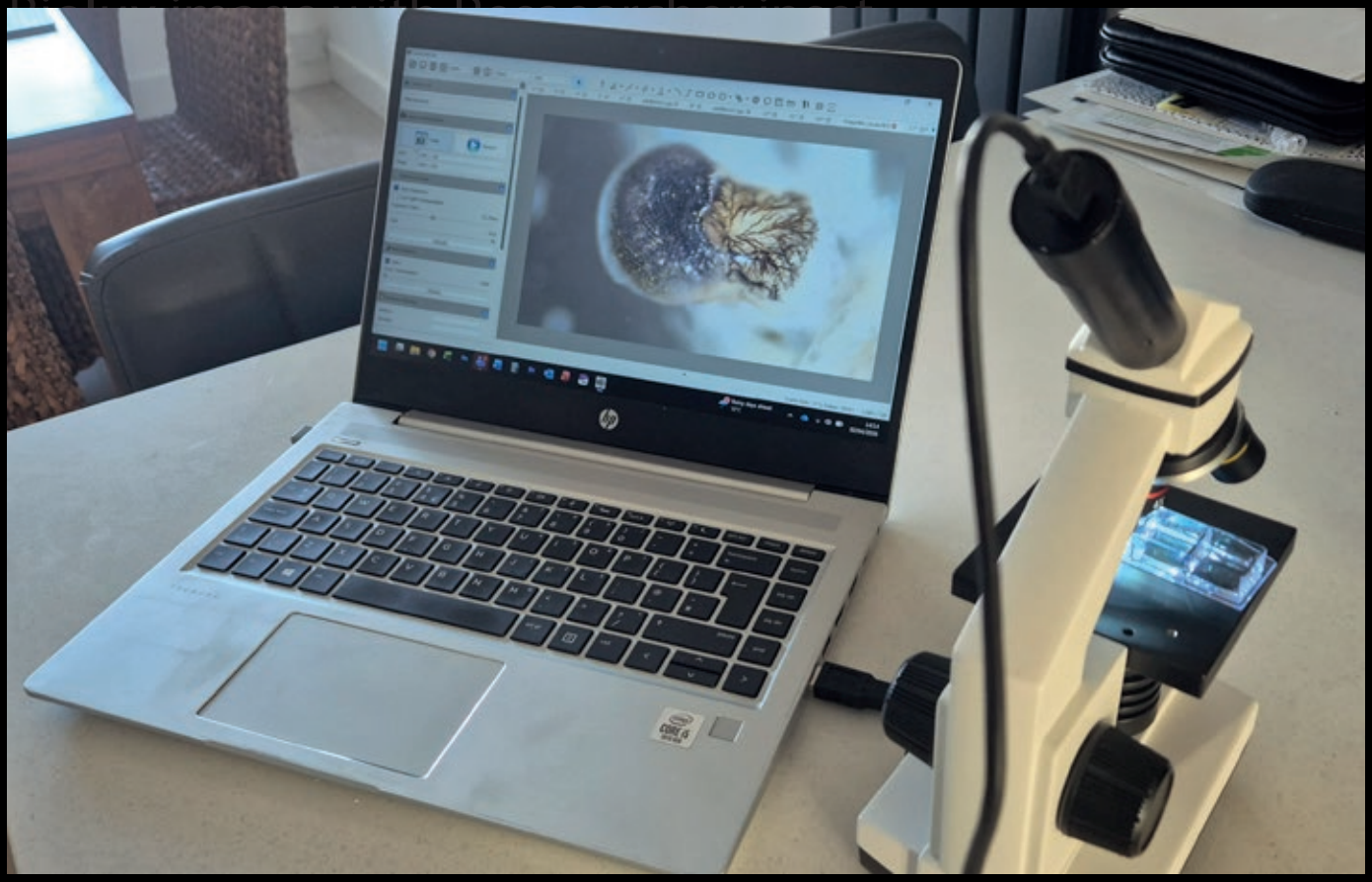
This Bresser Researcher LCD is a little more expensive but boasts it's own built in screen.

comes up through the slide from the bottom) is crucial for identifying algae, dinos, and diatoms. Some basic level 'scopes even provide multiple source lighting meaning subjects can be illuminated from the top if needed (which is useful for slightly larger, or non-transparent subjects).
A second type of microscope is a dissecting, or stereo microscope. While still of use for inspecting certain kinds of reef organisms, these are typically lower-power instruments designed for 3D viewing of solid specimens. They use two separate optical paths to produce a 3D image, featuring a long working distance for manipulating samples. This makes them ideal for biology, forensics, and inspection but you won't be able to use it to identify very small organisms. In either case, compound or dissecting, some models come with adapters for attaching imaging equipment. Some even come with high resolution screens attached. While these are typically a little more expensive, they can be ideal for people who may struggle to use an optical viewfinder.

As I already mentioned, I've gone 25 years in the hobby without a microscope and I really wish I'd had one much sooner. In addition to actually enriching my experience, I think it could have saved me a lot of trouble. I also think about all those fascinating hitchhikers I could have examined! Case in point, I recently suffered an algae outbreak in my own reef aquarium and a key part of dealing with this was to roughly identify what I was dealing with. This was critical as, particularly with pest algaes, they can often look very similar to the naked eye, yet require subtly different approaches to resolve. In my case, after having a particularly nasty cyanobacteria in my reef identified by a specialist

A selection of "marine mini-beasts" some taken with the Bresser camera and some taken with a mobile phone simply held up to the eyepiece. Top - a marine copepod. Below left: a Brineshrimp nauplii. Below right - a "darkfield" image of a copepod. Bottom left - the eye structure of a small amphipod that was left after a coral dip. Bottom right - Phytoplankton. It's worth remembering that it's possible to get in even closer with the optical eyepieces attached.





reef-keeping shop (Yorkshire Reefs), I decided to approach Bresser, a leading microscope provider, with the idea for this article. I was thrilled when they agreed to loan me a simple beginner scope – the Biolux NV. On receipt, I immediately pressed this into action, first on some residual issues I was experiencing in my tank, and then more widely as I realised a whole new cast of reef organisms was accessible to view up-close. A simple trip to my local fish store (Finest Aquatics, Widnes) and search of their live food fridge yielded several potential subjects immediately. Oppositeare some images of these commonly available reef micro-beasts that you could easily acquire and examine yourself… and of course this is before we even delve into the mysteries our own reef tanks. Don't forget you can also use a scope to look at non-reef subjects (think freshwater tank, pond or koi), and you can even buy pre-made slides to enjoy! If you've got kids, who knows, this might even "unglue" them from their phones for a while!

That's it for this feature. I may well see if I can convince Bresser to loan me a more advanced model for a coming issue so we can see what results a little more investment can achieve. Watch this space!

The Bresser Biolux NV 20x – 1280x is a great option for starting off with microscopy, and should make a useful addition to your reef-keeping equipment. This compound microscope comes in a hard carry case along with extras including a mechanical cross table (which is brilliant for positioning your slide precisely), 5 prepared slides and even a small brine shrimp hatchery! It also includes a 1280x720 camera which can be connected to a PC or laptop via USB cable. It also features multiple light sources, a light dimmer, and a filter holder. It retails (at the time of writing) for just £160.99. For those who fancy some a little more, well, fancy… consider the Bresser Researcher LCD which adds a 7" touch screen monitor (see image on page 41). I've visited plenty of large tanks over the years where such a scope would make a fabulous investment to the slick filtration rooms that often support these high value tanks.

A Clear Idea

Part 2

If you read my first installment back in the December issue, things were going generally well with my new system (the UltraMarine "office tank"). Although Part 1 covers the fundamental design and basic setup of this system in detail, to briefly recap, this is a Cleair Reef Midi system which was kindly donated to me by Shirley Aquatics (check out their ad on the inside back cover of this issue for a discount code of these systems!).

At 200 litres in volume it is very modest in size, and overall a simple set-up, particularly being in it's early stages. I "wetted" the tank in September last year, so it is just passing the 6 month old mark.

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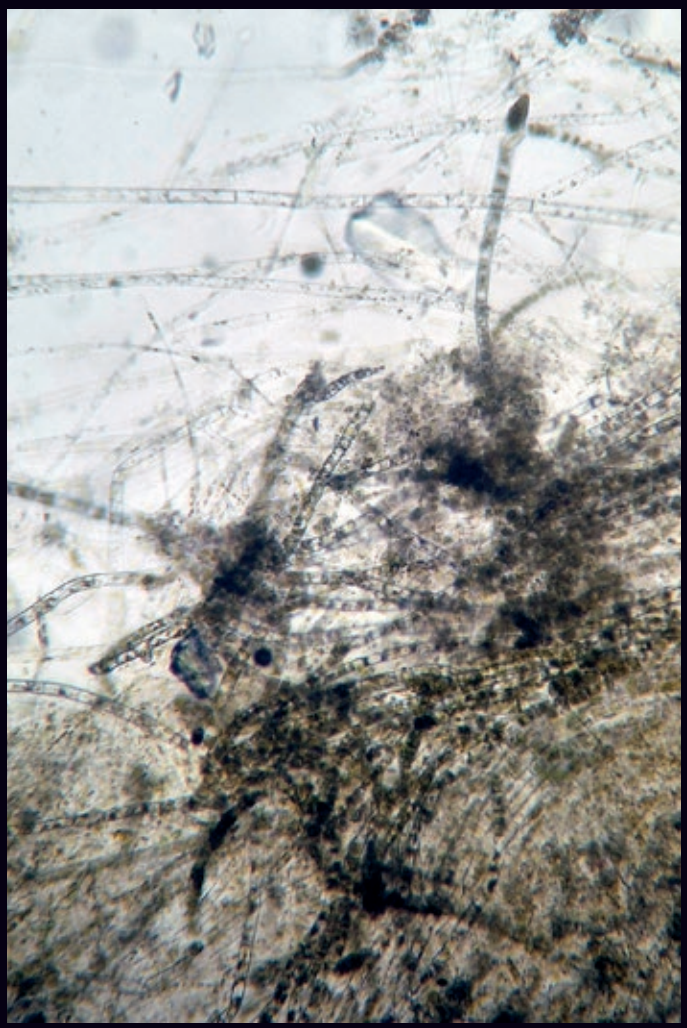
Back when I concluded my last installment on this sytem, it seemed to have matured biologically (certainly in terms of the nitrogen cycle) and water conditions appeared to be excellent (backed by basic tests of course). After cycling the tank for a couple of months with saltwater acclimated mollies, I had successfully introduced a couple of small reef fishes, plus some early "tester corals" (plus one or two nice pieces that I just couldn't resist during the Black Friday sales). I even experienced a bloom of copepods and everything (it seemed) was heading in the right direction… then almost overnight, boom… things suddenly changed.

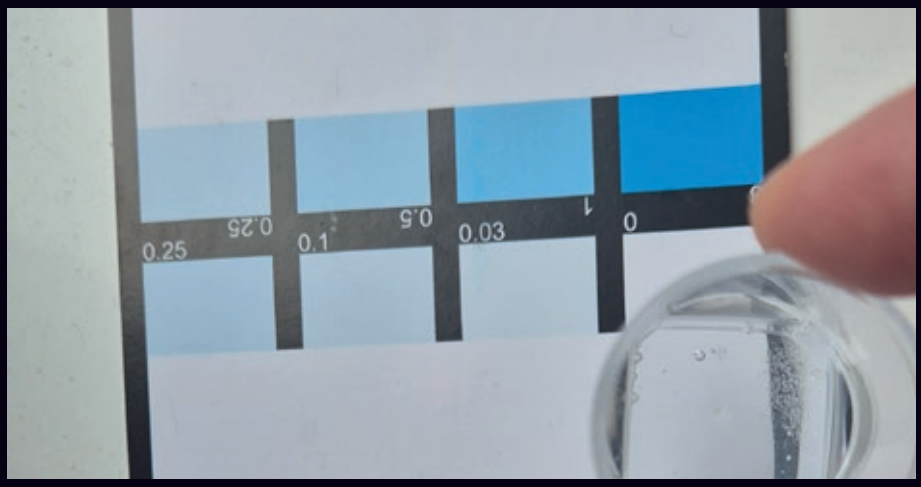
Nooo! It was going so well, then all of sudden his horrific fuzzy grey "growth" took hold on the rockwork, sand and even the glass! It was worse than it looks in this image if you can believe it!

The first hints of trouble were strands of greyish algae on my rockwork. Then, over the space of week or two, this spread to cover the tank glass and substrate too. Not wanting to make a knee-jerk reaction, I waited for 2-3 weeks in the hope that this would simply burn itself out as some minor element responsible for fuelling the bloom was exhausted (silicate for example). Unfortunately, this didn't show any sign of happening. Furthermore, some of my corals were beginning to appear irritated from the encroachment of this "grey fuzz". Polyfilter didn't seem to help despite promising to absorb a range of potentially problematic substances. Given this, I decided to take a more targetted approach and the first step was to send a sample of the nuisance organism to Duncan and Saph at Yorkshire Reefs who I'd seen on my shop visit back in issue 101 had a microscope dedicated to indentifying pest reef organisms.

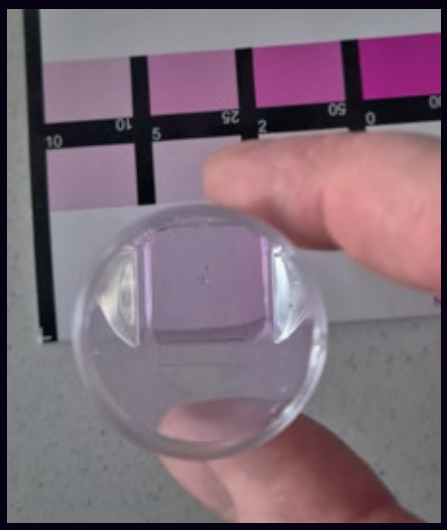
Suspecting Dinoflagellates or Chrysophytes, I was surprised when Dunc sent me images that suggested



It was time for action! I took a sample of the offending "fuzz" and sent it off to Yorkshire Reefs for microscopic analysis, and an expert opinion (this also prompted me to get hold of my own microscope as you may have seen in my "Microverse" article).



Above - Salifert kits revealed that both phosphate and nitrate had suddenly dropped to undetectable levels. Below - After some research, I got some potassium nitrate, then used an online calculator to determine how to mix and dose it. A couple of weeks later... finally a low level of nitrate!



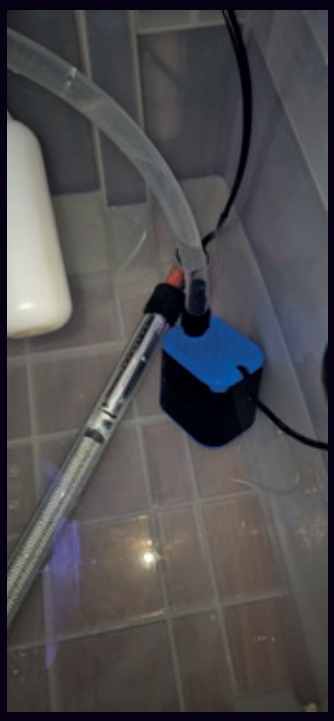
this instead was most likely a Cyanobacteria species of some kind. Using the microscope images as a reference, I took to Google and indeed the most similar thing I could find came back as *Lyngbya sp.* - a species that additional research revealed as a particularly nasty and toxic scourge, often responsible for complete tank breakdowns! In fact, I'm pretty sure this is the same stuff that led me to break down my last tank.

I decided that it wouldn't beat me this time though and after careful thought (and discussions with Dunc) I deployed a two prong attack. Of course, I had performed numerous water tests too, and the main take away from these was that both my nitrate and phosphate levels were completely undetectable using Salifert kits. While this is a known trigger for nuisance algae outbreaks, awareness of this situation doesn't necessarily make things any easier in my experience, instead presenting one with something of a dilema. When you are in this situation, it's impossible to know if nutrients really are low, or if excessive nutrients are being introduced and simply "gobbled up" immediately by the large population of algae present. Taking something of a leap of faith (albeit in the knowledge that my feeding regime and stocking ratio was far from excessive), I decided that raising nitrates would be prudent, certainly for the immediate welfare of my corals, so I began carefully dosing a solution of potassium nitrate (sodium nitrate would have been my first choice but I couldn't find this for sale anywhere). In tandem with this, I began dosing a 3% solution of hydrogen peroxide directly to the tank… just a few ml per day, and I undertook a large clean up of the tank, removing as much of the resulting slimy, floating material as possible. While it took increasingly large doses of potassium nitrate to show even a hint of pink on my nitrate test, over the next few weeks the tank did notably improve. The stringy grey growth did not return after being scraped, brushed and blown into mechanical filters (which were then rinsed) and was instead replaced with a dusty, reddish brown film on the rocks that was quite easy to blow away using a long coral feeder pipette. However, my two pokerstars montis became very pale and ultimately I lost both which was upsetting as they showed some promising initial growth before the outbreak (update.. one of them seems to be recovering as of early April). This was strange as other corals still seemed to be doing OK. It's worth noting that I removed the cover glasses around this time too. Perhaps all these changes at once were too much for them. I also introduced some grazing organisms in the form of 3 snails and a strawberry-lipped conch. While the snails did seems to consume the new film on the rock, their pace was too slow to keep up and I worried they were unusually lethargic. As it stands, I still see them occasionally but I do worry that if this really is *Lyngbya*, they may be ingesting

toxins through their grazing activities. Again, this presented a dilema as it seemed that grazing organisms were desperately needed, but the risk of snails dying in a tank carried it's own concerns, so I didn't want to add too many.

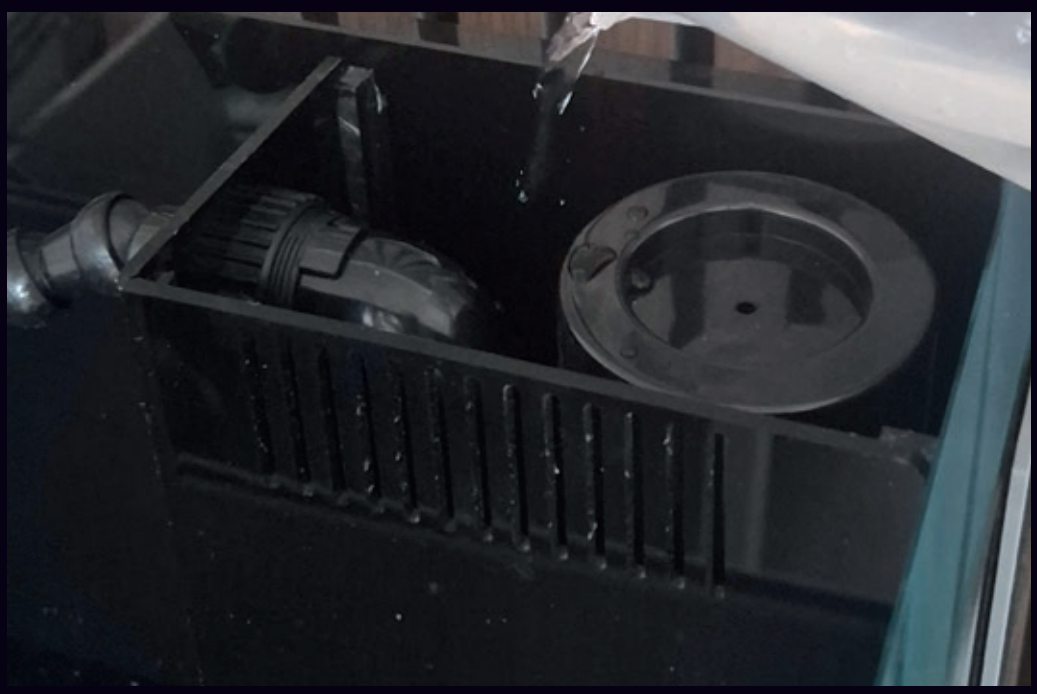
Jump forward a couple of weeks to while I am actually writing this article (early April) and things are definitely better. While the rockwork looks much cleaner, I am getting a small amount of the more usual red cyano mat on my substrate in a few places. This is with the merest hint of phosphate, similarly just detectable nitrate (I'm not going to claim to know the exact "ppm" but it appears to be 0.03 and 10ppm respectively), and a stable alkalinity of 8dKH. Other than increasing flow a little to see if this helps, this substrate cyano isn't bad enough to warrant any action as yet, rather I am hoping it will naturally diminish (failing that, after reading Saph's "Matter of Opinion" piece in this issue... I may look at my phosphate level in more detail!). I did add a nice green polyped leather coral recently though as this was also on a piece of live rock (which I thought should also add some bacterial diversity to the tank). Finally, I added a gorgeous juvenile *Ctenochaetus truncatus* (silver spot bristletooth tang) in the hope it will perform a grazing and coprophagous role. On this latter point, my midas blenny produces a surprising amount of droppings and these aren't touched by my *Nassarius* snails for some reason meaning they do tend to accumulate! I also find that I have to blow detrius off my rockwork several times a week (using along coral feeder pipette). I know people will immediately say that this indicates insufficent flow, but I don't think this is that case, rather I think that there is

Above: A juvenile *Ctenochaetus truncatus* is now helping with grazing duties. Below: I've also added a *Plectranthias inermis* (Hifin perchlet). This fish exhibits red fluorescence in the evenings but needs target feeding. Bottom: I've added a few choice corals including this Koji Wada Pink Nephthea from AAC. While I've got a long list of other corals I want to try, I am mostly buying frags to save money and to try to see them grow.



This little pump from AQQA is ideal for pumping water up out of my water mixing container into the tank. It is just the right strength to pump 25 litres over the space of 5 minutes or so... not too fast and not too slow. The speed and even on/off setting can be controlled via the inline remote.

still a coating of algae that is trapping detritus. Hopefully this will eventually improve. To summarise, so far this tank has been quite a challenge and I must say it does make me miss the seemingly-simple days of real ocean rock and luscious green hair algae outbreaks! At least these could be tackled by adding grazer species, unlike today's dino/cyano/chryso blooms which sometime seem to be toxic. Hopefully I'll have more positive news to report in the next instalment anyway, and that the tank looks more impressive. I hope that these trials and tribulations at least prove useful to anyone else experiencing similar issues so I'll continue to report back, warts and all. If this does turn out to be successful I'll definitely have earned it this time!



This image shows the weir box of the Cleair with the lid removed (I took this pic when setting the tank up). Note that this tank only has a single overflow pipe. While this works perfectly, I often remove the silencer cap shown as it doesn't clear the water surface otherwise. With the weir cover in place there's shouldn't be any chance of anything blocking the pipe. It does make it a little noisier though.

The Tech Side

While the biological side of this tank has been a bumpy ride so far, the basic systems and design of this Cleair tank continue to perform well. Initially as source of slight concern, the single pipe overflow works perfectly in practice although is a little noisy. I find that the silencing cap on the overflow pipe (under the weir lid) reduces noise when fitted but also means that the surface film doesn't get skimmed-off. Given the tank is in an office away from "public" areas of the house this doesn't cause a major issue for me and I often leave it off. Of course, on the plus side, having a single pipe means there is no valve that needs to be twiddled either. While the tank itself is running well, my skimmer has overflowed a total of 3 times now and there often doesn't seem to be any particular trigger for this (no change in sump water level, not after adding anything to the tank etc). Luckily, no foam or water has escaped the sump on each occasion, but I do wonder how the dumping of skimmate back into the system has affected things. While I did regular water changes early in the tank's life, I have reduced these now. When I do need to do a change, I recently sourced a useful little pump from AQQA, the same company behind the mini gyre pumps in this tank. This inexpensive little water pump is perfect for transferring water from my mixing tub back up into the tank at just the right speed, and it even has an inline controller that allows it to be turned on/off, or the speed adjusted (much better than fiddling with plug sockets!). The outlet also fitted a length of pipe I already had which is something most of the other pumps I've had have failed to do. Honestly, I found it really ridiculously hard to find a

pump that would fulfil this role so check them out if you are looking for a similar solution.

Another major change has been the installation of a dosing pump and D-D very kindly sent me a P1 Pro single dosing pump to fulfil this role. Super simple to set up and use, this pump is ideal for delivering Reef Zlements "InOne" to replace the minerals consumed by this system. In the early stages, consumption is still very low but I've got this pump linked up to my dosing container now, and I even smartened up the dosing container "window" that I cocked-up (see part one) with some creative use of foamboard. I think it looks pretty good considering! On the subject of the cabinet aesthetics I've also added some HexLok panels courtesy of Jonny at AquaPrint. Opting for black fittings, this system has proven really useful in helping me to organise my "bits and bobs" which would probably be lying in a chaotic heap on a table otherwise. I also grabbed some cool 3D printed skull frag mounts from Jonny and I hope to get these encrusted with coral eventually. It's a little experiment that adds some interest for me.

Finally, I've added two items of ancillary equipment which might not be in the armoury of the typical hobbyist. The first of these is a portable powerstation, specifically a Bluetti Elite 100 V2. Although this unit has the capacity to operate like a UPS (being plugged in, and having items of equipment connected to it so, in the event of a power outage it will seamlessly take over the running of those items), I don't actually run it like this. I just leave it next to the tank charged and ready to plug one of my mini gyres into if needed (as barring the odd business trip I'm never really more than an hour or two away from the tank if needed). While my house has been prone to sometimes lengthy powercuts over the years, I've always managed to get by with simply using a jug to swich water around every hour or so, and recently the infrastructure has promised to reduce these instances so fingers crossed I won't even need it. Of course, a unit like this could also be useful for activites such as camping, and with the addition of solar panels, could even come in useful in some kind of apolcalyptic scenario… which, let's face it, isn't beyond the realms of possibility these days! I suppose if that happened, keeping a reef tank going wouldn't be top priority anyway! Finally, I also sourced a microscope recently (after my Lyngbya experience). I won't go into too much detail here about this as I actually decided to write a separate article on this potentially extremely useful bit of kit.

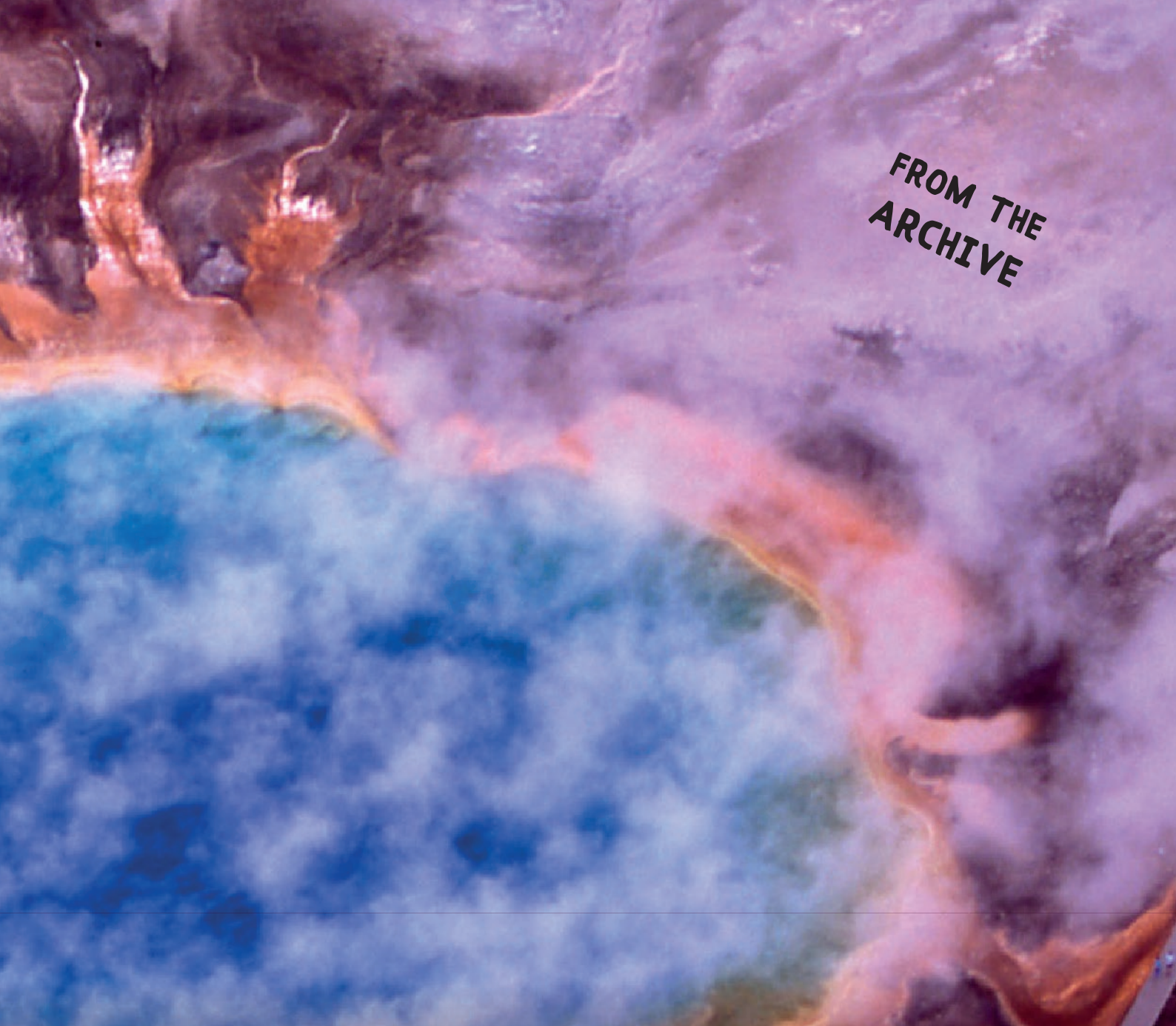
Above: I've now started supplementing the tank (in terms of minerals and trace elements) with Reef Zlements "In-One" which is delivered by a D-D P1 Pro dosing pump. I've really reduced my water change frequency too. Below: I added some Hex-Loc panels from AquaPrint to help organise my equipment. Jonny sent me some 3D printed skulls too which are great for holding newly introduced frags. I'd love to be able to get one encrusted with coral but I think this may take a while!

Above: My Bluetti Elite 100 V2 powerstation sits on top of a custom shelf that I made (which also conceals my RO unit). With the cabinet doors open you can see my control panel with now-completed dosing container viewing window (at the bottom).

Replicating blue hued tanks is very tricky in print due to the CMYK colourspace used, but here's my attempt at showing the tank during the evening. I must say this is my favourite time to sit and enjoy the tank as the fluorescence is just insane (especially with orange glasses on). This image was taken in early April and I've added a few more small frags in that time period. Hopefully they'll get growing in time for the next installment!

Anaerobic Photosynthesis in the Marine Aquarium

Kenneth resides in Colorado where he works as a freelance nature and aquarium science writer. He studied in the Pacific Northwest, where he obtained a degree in Biology at the University of Oregon as well as a certificate of completion in the Oregon Coast Community College Aquarium Science Program. His interests have led to projects ranging from freshwater paludaria to temperate marine aquaria, and work ranging from wholesale aquarium fish sales to laboratory aquaculture. Read more about Ken at: **ultramarinemagazine.co.uk/contributors/**



FROM THE ARCHIVE

The marine aquarium hobby has changed so much over the last couple of decades. Today, we are commercially propagating species that were once believed to be unable to merely survive in captivity for any length of time. To what do we owe this increased measure of success? Surely, some of this can be credited to advancements in technologies ranging from lighting to filtration devices. But, arguably, advanced methodologies have also played a big role here. So-called natural methods have been particularly influential, being used to some extent in just about every modern aquarium system.

To be considered "natural" in any form or to any degree, a marine aquarium system should closely replicate the coral reef ecosystems from which most of our livestock originates. This necessarily requires that all types of life are present—not just the big, pretty stuff like fishes and corals. In other words, it requires a shift of mindset from one that is fixated with macroscopic lifeforms to one that also recognizes the value of certain microbes (especially primary producers and decomposers).

Sure, aquarists have long understood the importance of nitrifying bacteria (i.e. those that convert harmful ammonia and nitrite to relatively harmless nitrate); maybe denitrifiers (i.e. those that convert nitrate to nitrogen gas) have come in it at a distant second place. But until fairly recent times (with the increased use of aerobic heterotrophic bacteria, for example), that was about it. Nitrate levels were controlled mainly by massive water changes, dissolved organic matter levels were controlled mainly by granular activated carbon, and so on. In many cases, such methods proved to be reasonably effective at maintaining acceptable water parameters. Still, they were quite unnatural.

So, what really is the difference here? For one, naturalistic aquaria are (at least for most of us!) much more interesting and rewarding. But that does not explain why they can be so much more successful.

Naturalistic systems are comparatively balanced, stable and self-sustaining. To the point, where certain key microorganisms are present and in the right abundance, they not only help to improve water quality; they also support animal health more directly through dietary enrichment and enhanced disease resistance. This article discusses some with these benefits with a focus on the natural history of a diverse group of prokaryotes, the anaerobic photosynthetic bacteria.

A microbial planet

Earth formed around 4.5 billion years ago. It was fairly hospitable to life from the get-go, with the first lifeforms emerging just a half-billion years later. Of course, the term hospitable is relative here; in its youth, our planet was scalding hot and nearly devoid of oxygen. Indeed the earliest organisms would be chilled to death or poisoned by oxygen in most of today's habitats (which is why their most direct descendants are relegated to "extreme" environments such as deep sea hydrothermal vents).

The four major metabolic pathways—chemoautotrophy, chemoheterotrophy, photoautotrophy and heteroautotrophy—had all evolved before the appearance of the first eukaryotes. In fact, most biologists agree that they all probably existed within the first billion years of Life. There is less agreement, however, as to their specific sequence of development.

No one is quite sure if the very first prokaryotes were heterotrophs or autotrophs. One might suppose that autotrophs (being capable of using inorganic carbon to build biomass) would be the most likely candidates. However, because glycolysis (a process that can extract energy from organic substances in anaerobic environments) is carried out by just about every known organism, many point to the heterotrophs. Proponents of this latter theory suggest that their "food" came from organic compounds in the primordial soup of primitive Earth. According to this hypothesis, natural selection eventually favored autotrophy (especially photoautotrophy) as food sources became depleted from the ancient ponds and seas.

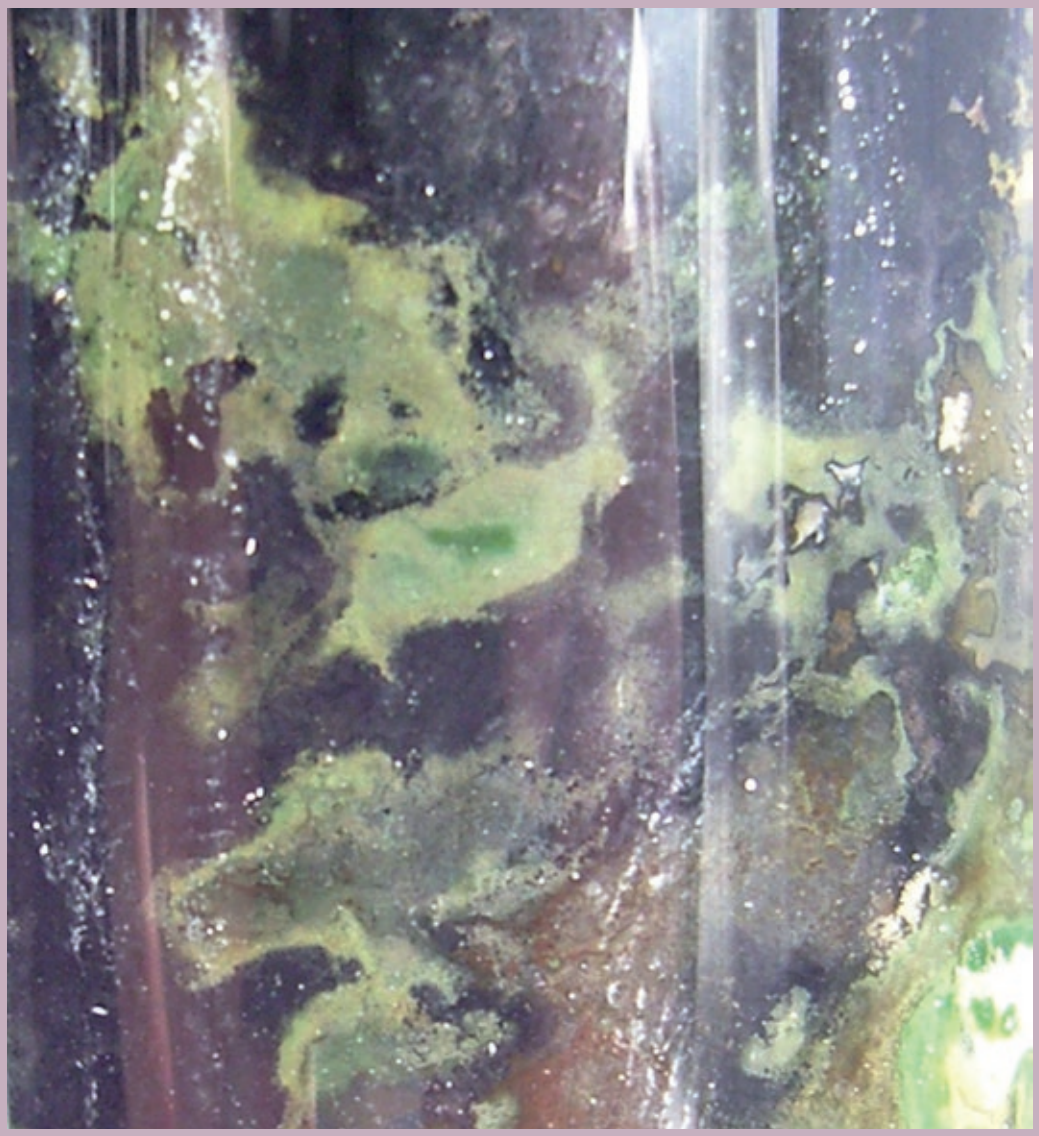
The rise of photosynthesis

We have pretty good evidence to support a very early appearance of phototrophic organisms. For one, an extremely wide variety of bacteria are capable of photosynthesis. It is certainly possible that this ability evolved independently within many different, distantly related groups. However, because of the striking similarities between each group's photosynthetic machinery (which is quite complex), we must rule this hypothesis as unlikely. It is actually much more plausible that non-photosynthetic groups that are related closely to photosynthetic ones simply lost their phototrophic capabilities during the course of their evolution.

The most ancient phototrophs are not much like those that are predominant today. These organisms (the anoxygenic photosynthetic bacteria) employ a photosystem that extracts electrons from compounds such as hydrogen sulfide or organic matter. Some others are additionally capable of chemoheterotrophic growth under aerobic conditions (like us!) using fatty acids, ethanol and organic acids as carbon sources. Ammonium is frequently used as a nitrogen source, though certain groups are capable of carrying out nitrogen fixation.

The complex pattern of stratification among anaerobic microbes can easily be observed in tall, clear vessels known as Winegradsky columns. Photo by Søren Overballe-Petersen.

Isolated cultures of some photosynthetic bacteria exhibit extremely vibrant hues. Photo by U.S. Department of Energy.



A mature growth of green photosynthetic bacteria. Photo by kOchstudiO

The cyanobacteria, which probably evolved from an anoxygenic ancestor as far back as 3.5 billion years ago, were the first organisms to perform oxygenic photosynthesis. In this process, water molecules (rather than sulfurous substances) are split during light reactions to release oxygen (rather than hydrogen). Cyanobacteria dramatically altered the planet by greatly increasing the oxygen content of its atmosphere. They remain as the only oxygenic prokaryotes and are the ancestor of the algae (and consequently all plants).

Everything in its place

Throughout the Earth's history, microbes continuously changed the physical and chemical environment around them. As they did so, new forms evolved to thrive in the new conditions. Many ancient forms persisted, though they retreated to what favorable habitat remained (for example, obligate anaerobes escape oxygen by living in deep, anoxic sediments).

This has resulted in the rich and complex microbial communities that we observe today. Rather than a homogeneous mishmash of organisms, these assemblages are striking in their highly ordered structure. Though highly interdependent, these groups are predictably arranged within distinct zones. Each is zone is characterized primarily to its exposure to oxygen as well as light. This pattern of zonation is especially pronounced in quiet waters where there is little mixing of the sediments (for a more detailed treatment of this topic, refer to "Mud in the Marine Aquarium" in the June 2016 issue of this publication).

Categorising microbial life in this way not only helps to make more sense of their evolutionary history, but it is also the best way to describe

their various roles in nitrogen, carbon and sulfur cycling—a major point of interest to the marine aquarist.

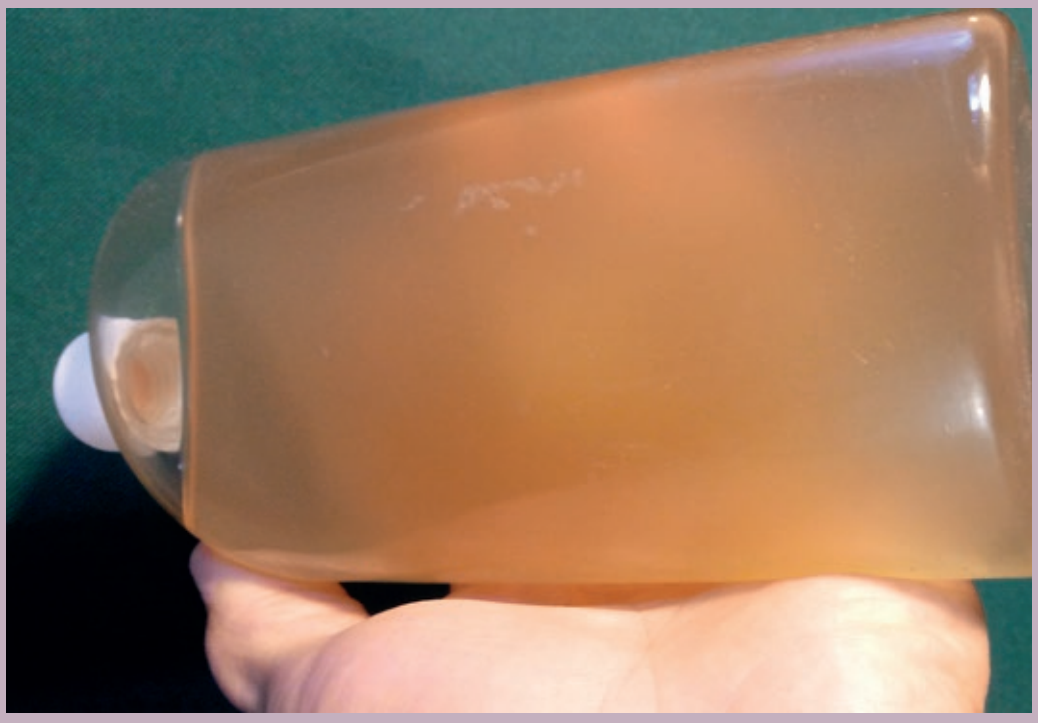
Meet the anoxygenic photosynthetic bacteria

Photosynthetic bacteria can be divided into a whopping 35 distinct groups. To make this somewhat intimidating mode of classification a bit easier to swallow, one may start by dividing these into two broad groups, the anoxygenic photosynthetic bacteria and the oxygenic photosynthetic bacteria. Based upon pigmentation, the anoxygenic group includes the purple bacteria and the green bacteria. The oxygenic group includes only cyanobacteria (a recently discovered type of oxygenic bacteria has been placed under the prochlorophyta, bridging the gap between cyanobacteria and the chlorophyta (i.e. green algae)).

Purple bacteria are anoxygenic phototrophs that generally grow under anaerobic conditions. These organisms can grow autotrophically with carbon dioxide (carbon source) and hydrogen or reduced sulfur compounds (electron donors). Photoheterotrophy or chemoheterotrophy might also support growth. They often require certain vitamins. While some of them can grow under aerobic conditions, none can perform photosynthesis in the presence of oxygen.

The internal photosynthetic membranes of purple bacteria are arranged in flat sheets (i.e. lamellae). The photosystem shuts down under extremely intense light, whereas the cells beef up the lamellae when grown under low light. These membranes contain photosynthetic pigments. Purple bacteria produce bacteriochlorophyll a and b as well as carotenoids. Despite their name, they may appear as brown, orange or pink

A mature growth of purple photosynthetic bacteria. Photo by kOchstudiO.



Depending upon species and environmental conditions, "purple" bacteria (*Rhodopseudomonas palustris* shown here) can occur in various colors including bright orange. Photo by Kenneth Wingerter.

Nutrients are efficiently recycled as (1) bacteria sequester dissolved wastes, (2) small bacteriovores such as amphipods graze on biofilms and (3) fishes consume the bacteriovores. Photo by Kenneth Wingerter.

Purple non-sulfur bacteria have been identified as a potential superfood for the notoriously finicky carnation corals. Photo by Dr. Dwayne Meadows.

depending upon carotenoid content. It is their carotenoids that may impart a purple hue (mutants that lack carotenoids are blue-green, the actual color of bacteriochlorophyll a). Pigment synthesis is repressed by the presence of oxygen.

There are two main types of purple bacteria: the purple sulfur bacteria and the purple non-sulfur bacteria. The purple sulfur bacteria are motile, Gram-negative bacteria that contain both bacteriochlorophyll a and b. They are able to grow chemolithotrophically in the dark using thiosulphate as an electron donor. They are also chemoheterotrophs, using compounds such as acetate or pyruvate. They grow only in anaerobic conditions.

The purple non-sulfur bacteria were once believed to be incapable of using sulfide as an electron donor (hence their name). We now know that they can indeed utilize small amounts of sulfide, though the concentration of sulfide used by purple sulfur bacteria is lethal to them.

This group is known to be among the most metabolically versatile of all lifeforms. They usually behave as photoheterotrophs, using compounds such as amino acids, benzoate and ethanol as food. Like the purple sulfur bacteria, they may contain both bacteriochlorophyll a and b. Unlike purple sulfur bacteria, they may grow as chemoheterotrophs in both aerobic and anaerobic conditions.

The cells of green bacteria typically are smaller than those of purple bacteria. They are Gram-negative and do not require vitamins for growth. Due to certain carotenoids, these microbes are often brown rather than green. Apparent color therefore cannot provide conclusive identification. Green bacteria contain a small amount of bacteriochlorophyll a as well as bacteriochlorophyll c, d or e.

Generally, green bacteria are obligately anaerobic and photoautotrophic. They utilize hydrogen sulfide, hydrogen gas or thiosulfate as an electron donor and carbon dioxide as a carbon source. Their photosynthetic apparatus is known as a chlorosome. Differing significantly from lamellae in structure, these consist of a several cylindrical structures beneath and/or attached to the cytoplasmic membrane. They are enveloped within a thin membrane.

There are two main types of green bacteria: the green sulfur bacteria and the green non-sulfur bacteria. The green sulfur bacteria are non-motile. Their cell bodies take the form of rods, spirals or cocci. Some have anchor-like appendages known as prosthecae. They are strictly anaerobic and are obligate phototrophs. They occur only where hydrogen sulfide is abundant. Sulfur is deposited extracellularly.

The green non-sulfur bacteria are filamentous, gliding bacteria. They are both photoheterotrophic and photoautotrophic. Some are facultatively aerobic, though chlorosomes are present only when grown anaerobically. They produce bacteriochlorophyll *a* and *c* as well as β- and -carotenes. They do not extracellularly deposit sulfur. Most species are thermophilic and so are not as commonly encountered in coral reef environments.

Appreciating the little things

Green and purple bacteria can be found in most mature aquarium systems. In some cases, they can reach a great enough density as to be seen by the naked eye (as evidenced through the coloration of sediments). Their visibility can be enhanced in marine aquaria where an aragonite (that is, light-colored) substrate is in use. Multiple colors—laid out in layers—might be observed in

relatively stagnant areas where the substrate has been left undisturbed for long periods of time.

When present, anaerobic phototrophs are mainly sandwiched between a layer of filamentous cyanobacteria, nitrifiers and heterotrophic aerobes (at the sediment surface) and methanogenic, sulfate-reducing and denitrifying bacteria (deeper within the sediment). They usually reside just a few millimeters below the substrate-water interface, where oxygen has been depleted but some light can still pass.

Just below a pinkish/purple layer (purple bacteria) one might observe a greenish layer (green bacteria). When observing a substrate sample under the microscope, an abundance of yellow-white granules indicates a healthy population of purple sulfur bacteria. Purple non-sulfurs sometimes occur with (but are obscured by) purple sulfurs. Green non-sulfurs reside closer than green sulfurs to the cyanobacteria, upon whose organic secretions they feed. Green sulfurs oftentimes do not exhibit their green pigments, with only their yellow-brown accessory pigments visible. These usually reside deeper and nearer sulfate-reducing bacteria (black layer), which produce copious amounts of hydrogen sulfide.

So long as they do not reach plague proportions (particularly the cyanobacteria), these microbial mats are not undesirable. They certainly are not *unnatural*. Yet, aquarists often fret and take all kinds of measures to eliminate them through the excessive use gravel vacs, sand-sifting animals, etc. It would seem that bleached-out, sterile, dead sand is what they desire. This is unfortunate, as it eliminates an entire biological community that is both fascinating and beneficial.

Wait, beneficial?

Yes, and particularly so if you aim to develop a natural, low-maintenance system. This is firstly due to the fact that these microorganisms collectively work to drive carbon, nitrogen and sulfur cycles within your captive ecosystem. Pollutants and excess nutrients are either efficiently gassed off or are locked up in bacterial biomass (a process referred to as the microbial loop). Most notable to the average aquarist is the fact that a healthy sub-sediment microbial community will help to clarify water, slow the accumulation of detritus and control nuisance algae.

Promoting photosynthetic anaerobes

It is worthwhile to take proactive measures to encourage the development of a healthy community of benthic microbes. This certainly would include pampering anaerobic photosynthetic bacteria, but would necessarily include other types as well. Above all, this involves providing them with a good home. Truly "live" sand would be a great place to start here. Presumably, it has been inoculated with a nice diversity of microbes. But even dry, barren sand will eventually develop into a dynamic microhabitat if allowed to mature properly. Ultrafine sands or muds are ideal. For those who insist on the crisp-white-sand look, or (heavens forbid) a bare bottom, a suitable living space can be created by adding a thick sand bed to a sizable refugium.

The importance of aquarium substrates is frequently underestimated. Photo by Dungodung.

Perhaps one of the most critical factors is substrate depth; the sediments must be sufficiently deep that there is a good amount of anoxic space for anaerobes to thrive. Something like five centimetres will usually do. However, if courser grained substrates such as crushed coral are used, something a bit deeper might be necessary; the same can be

You should be able to acquire commercial PNS products like the ones above (produced by Hydrospace), at good quality, specialist reef outlets. Shown here at Finest Aquatics in April 2026 - image J Clipperton

Nutritional Modes of Bacteria			
Type of Metabolism	**Source of energy**	**Source of hydrogen and carbon**	**Example(s)**
Photolithotrophic autotrophy	Light	Inorganic H/CO_2	Purple and green sulfur bacteria, cyanobacteria
Photoorganotrophic heterotrophy	Light	Organic H/Organic C (CO_2 may also be used)	Purple and green non-sulfur bacteria
Chemolithotrophic autotrophy	Inorganic compounds	Inorganic H/CO_2	Nitrifying bacteria
Chemolithotrophic heterotrophy	Organic compounds	Organic H/Organic C	Heterotrophic bacteria, some denitrifying bacteria

recommended if an abundance of burrowing animals (e.g. *Nassarius* snails) are to be used.

Lighting should be fairly intense, particularly in tall tanks or planted refugia with dense vegetative canopies. At least in the lab, most types of lighting (by their own reports) seem to do the job. But, if you really want to go all out for your green and purple bacteria, just remember that bacteriochlorophylls take on the most absorption near the ultra-red spectrum at around 770 nm.

Because aquaria are inherently unstable environments (especially when first set up), many members of the bacterial community can get killed off or simply out competed. Since they live in marginal habitats and have rather exacting requirements for growth, this is especially so for photosynthetic anaerobes. Luckily, a wide variety of live bacterial products are becoming increasingly available to aquarists. In addition to introducing new species, these bottled inoculants can (1) increase the numbers of and (2) add genetic diversity to an existing population. When boosted to very high densities, some (e.g. purple non-sulfurs) act as highly effective probiotics.

Bacteriology has been steadily gaining interest in the aquarium hobby, and for good reason. As we up our game with increasingly difficult and specialised fish and invertebrate species, it is becoming more critical that we provide an optimal (and, if it may be said again, natural) aquarium environment. The best way—perhaps the only way—to accomplish this is through the methodological cultivation of a well-developed ecosystem. As many of us already understand well, this requires the inclusion of certain microorganisms. The anaerobic photosynthetic bacteria rank chief among them and it should not come as a big surprise, being that the entire modern biome as we know it evolved around them!

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easy reefs®

FEED THE IMPOSSIBLE

Easy reefs was founded over 20 years ago with a goal to provide a comprehensive feeding solution for reef aquariums, based on three different pillars: **fish feeds**, **coral feeds** and **plankton cultures**. Over time, this original concept expanded into several additional areas, as described below:

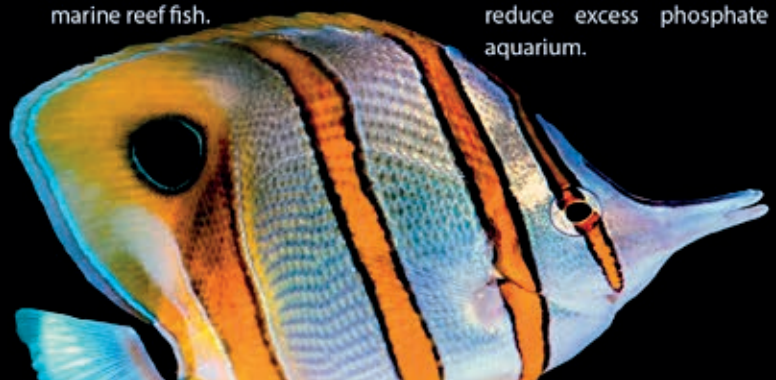
Masstick

Revolutionary 100% natural food

Masstick is the product that best embodies our core values. It delivers outstanding results and creates a real "WOW" moment when you see how even the most complicated fish eagerly feed, which explains its popularity. But it represents much more than that…

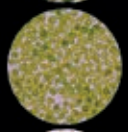
The lyophilisation process preserves all the nutritional and organoleptic characteristics of the raw materials that compose it. This manufacturing process allows us to keep intact natural molecules which are involved in the olfactory process of finding food for fish (fish have specialised cells in the olfactory epithelium to detect these molecules), that's what makes this food so irresistible.

Masstick is primarily made from shrimp of the species *Palaemonetes varians*, which provides an optimal nutritional profile rich in amino acids and essential fatty acids for feeding marine reef fish.



We also incorporate 4 different species of microalgae with functional characteristics:

Tetraselmis chuii
Antioxidant properties and high digestibility. Rich in fatty acids EPA, ARA, proteins and vitamins B12, C and E.



Isochrysis galbana (T Iso)
Good for essential fatty acids for marine animal metabolism. High in proteins and also functional polysaccharides.

Nannochloropsis gaditana
Probiotic functions. Rich in fatty acids EPA, ARA, DHA, GLA, antioxidant pigments and active peptides.

Phaeodactylum tricornotum
Packed with fatty acids EPA, lipids, 1,3 β-glucans and high protein content. Strengthens the immune system.

Masstick can be offered to fish in a way that allows for very precise dosing. Because it sticks to the glass or rocks, you can control exactly how much food is provided, preventing it from drifting into inaccessible areas where it could go un-eaten and pollute the aquarium. In addition, it can also be mixed with medications.

Another key point about Masstick is its exceptionally low protein to phosphate ratio, among the lowest available, thanks to its crustacean based composition.

In many conventional feeds, phosphate comes from the skeletal material in fishmeal. Much of this is not fully utilised and is excreted, leading to increased phosphate levels and related water quality issues.

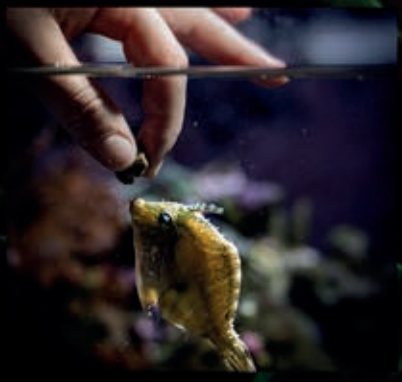
Masstick contains no fishmeal and provides only the phosphorus needed to support healthy fish, helping to reduce excess phosphate in the aquarium.

Easymasstick

Stick-on bites experience

Following feedback from hobbyists, many were looking for a product of this quality with a simpler application. In response, we explored various options and introduced Easymasstick, a ready to use version.

Simply take a piece, gently knead it, press it onto rock, glass or decoration, and enjoy watching your fish feed.



DKI Marine

Masstick's legacy

DKI Marine was developed as an alternative format using the same high-quality ingredients as Masstick, which is why these pellets are so naturally appealing to fish. Available in 0.6 mm, 0.8 mm, 1.2 mm and 2 mm sizes, they are designed to suit most species commonly kept in reef aquariums.

Alongside this, our range of liquid coral feeds reflects years of development focused on both quality and ease of use. We believe a leading product should not only meet high nutritional standards but also integrate seamlessly into everyday aquarium care.

All liquid feeds can be connected to a dosing pump using our connectors, allowing for precise and consistent delivery. They do not require refrigeration when stored in their original packaging at room temperature. The packaging protects against sunlight and, when used with a connector, compresses as the product is dispensed, limiting oxygen exposure and helping to prevent oxidation.

Easysps EVO

Power up growth and colour

EasySPS EVO is a liquid food composed of a natural blend of marine plankton, designed to be dosed with a pump to provide regular nutrition to SPS corals. Its formula provides high-value proteins, amino acids, essential fatty acids (EPA, ARA, and DHA), carbohydrates, and micronutrients which promote healthy coral growth.

With particle sizes ranging from 0.2 to 400 microns, it is easily captured by SPS polyps. Its use enhances both coral growth and colour intensity.

By stimulating metabolic activity, corals increase their uptake of nitrates and phosphates, helping to lower nutrient levels in the water. Faster growth also drives higher consumption of calcium, carbonates and magnesium.

For best results, it is recommended to use alongside Easybooster to prevent nutrient limitations and maintain system balance.

Easybooster

Boost your reef

Easybooster is a complete marine phytoplankton feed, rich in vitamins, essential fatty acids such as EPA, ARA and DHA, amino acids, proteins, carbohydrates, minerals and bioactive compounds that support key metabolic processes in marine life. It is ideal for sustaining microscopic fauna, filter feeders and corals.

As no single microalgae species can meet all nutritional needs, Easybooster combines four different marine phytoplankton species to deliver a balanced, comprehensive feed. It does not require refrigeration to preserve its nutritional quality and can be dosed accurately using dosing pumps, offering a practical and reliable solution for maintaining and developing microscopic life in reef aquariums.

Easybooster vs Live phytoplankton

An important consideration is the comparison between live phytoplankton and Easybooster. While live phytoplankton can be an excellent option, it is not always easy to source consistently fresh, reliable cultures that are safe for aquarium use. For this reason, we analysed a range of phytoplankton products on the market and compared them with Easybooster.

One of the key observations was the inconsistency in concentrations between batches, making accurate dosing more challenging. Easybooster, by contrast, delivers a consistent formulation and concentration every time. With some live products, varying concentrations can increase the risk of overdosing, potentially disrupting the balance of the aquarium.

In terms of concentration, our analysis showed that Easybooster can contain up to 200 times more cells than other alternatives on the market. Its concentration reaches 2.56×10^9 cells per ml, compared with a maximum of around 10^7 cells per ml in the other products tested.

Shelf life also proved a key difference. Live phytoplankton typically remained viable for only one to three weeks, whereas Easybooster, thanks to its production technology and packaging, maintains its properties for up to two years from manufacture.

It is also important to consider that, as live cultures begin to break down, they can release ammonia and nitrites, potentially affecting the chemical balance of the aquarium. Easybooster preserves cell integrity, ensuring a stable and safe product for regular use.

In addition, Easybooster is produced in a controlled, professional environment and undergoes rigorous quality checks to guarantee consistent concentrations, the absence of pathogens and the use of carefully selected, high quality strains.

But we don't stop there. We're continuing to invest in research and development with the goal of designing and optimising products of the highest quality that also help simplify and improve aquarium maintenance. These solutions are designed for hobbyist aquarists as well as research centres, public aquariums, and aquaculture systems, among other specialised sectors. We also remain firmly committed to innovation in the development of technologies and solutions for the reproduction of fish and corals, a field that undoubtedly represents one of the most promising and sustainable paths for the future of the hobby and aquatic sciences.

Easy Reefs is available from UK retailors, distributed by Aquatic Now

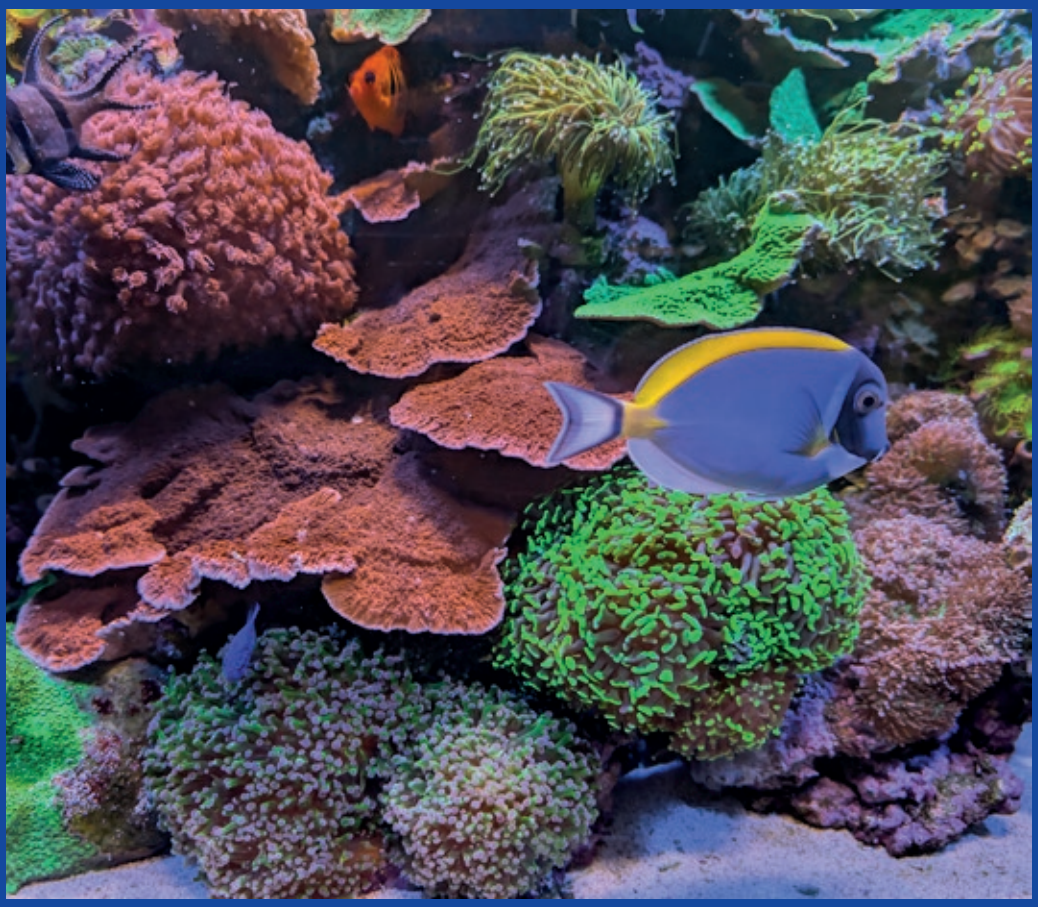
AN aquatic now

50+ Years in the Making

Just before Christmas, John contacted me and asked if I would be interested in doing a piece on my reef aquarium. While I felt quite honoured at being asked, I do worry that some may regard it as being an "ordinary" tank though.

Campbell started keeping both native and tropical marines in 1970 and became editor of the British Marine Aquarist's Association's journal Marinews for several years. Having left the hobby at this point he followed a career as a Physics and Science teacher till retiring in 2012. He continued to be active in education writing various publications and teaching material for Physics courses taught in Scottish schools. Having now returned to the hobby he has enjoyed catching up with the changes and advances which have taken place during his absence from the hobby. Read more at: **ultramarinemagazine.co.uk/contributors/**

It's not a stunning peninsula tank, not an enormous thousand plus litres nor stuffed with rare and expensive SPS corals or exotic fish. It's a modest 500 litre aquarium, very much like the ones that dozens of readers of Ultramarine magazine must own. But I'm pleased with what I've achieved over the years it's been set up and I think represents what, in my eyes at least, is a fairly natural looking miniature coral reef (which I'll happily accept that it's not really since it's stocked with species not normally found together!).



You may think the title of this article slightly odd but let me explain the history behind it. I first ventured into keeping marines in 1969 as a teenager who had been keeping tropical fish up until then. My local fish shop started to stock marine fish—I was hooked! My first venture consisted of converting a stainless steel framed 15 gallon (70 litre) aquarium with a home-made under gravel filter, topped with crushed cockle shells and decorated with bleached corals and filled with natural seawater. To this was added one fish, a domino damsel. It's hard to convey the excitement of those early pioneering days and eventually all four of my aquaria were converted to marines.

But marriage and a demanding career meant that the hobby took a back seat until I returned some 8 years ago. With a science background and my previous experience, I thought that setting up a new aquarium would be a doddle. First mistake—thinking a budget of £1000 would be sufficient. Second mistake—visiting a reef shop and looking at a display and saying "Those are nice anemones". No, those are LPS corals I was told. I obviously had a lot to learn as the hobby had advanced tremendously in those intervening years!

"I was on the start of a steep learning curve as I caught up with all the advancements that had taken place in those aquarium free years."

In fact, I was on the start of a steep learning curve as I caught up with all the advancements that had taken place in those aquarium free years.

This involved getting hold of any modern books on reef aquaria which provided helpful information on the basics (see Ultramarine:- Read All About It, Issue 89/August 2021 and Reading Between the Lines, Issue 108/October 2024). I also looked at several YouTube videos and prepared a list of what I thought would be required for my new set-up. Initially I was going to go for a custom-built aquarium but quickly changed this to a commercial manufacturer and ordered an Evolution Aqua Pro 1200S. I had a fairly good idea of the equipment I wanted, and my local fish shop directed me towards EcoTech pumps and lights and Nyos protein skimmer. These were more expensive than alternatives but were the best quality on offer at the time.

I suppose most reefers add items of equipment as they progress through the hobby and other items become redundant. My current equipment list is as follows:

1 x D-D Spektrum 150
2x EcoTech G6 Pro Radion XR15s
2 x EcoTech MP 40s
EcoTech Vectra M2 return pump
Nyos Quantum 220 protein skimmer
Nyos Torq G2 reactor
Red Sea ReefMat 500 roller filter
2 x D-D H2Ocean P4 Pro dosing pumps
D-D KH Manager
2 x D-D 300 W titanium heaters with D-D dual temperature controller
D-D H2Ocean compact auto top up
D-D 20 W UV steriliser (employed when new fish added)
D-D Funktion 5000 DC return pump (kept as a spare in case of return pump failure)

Aquaforest CO2 air scrubber

Various items of equipment which I've used in the past are now relegated to a shelf in the garage for one reason or another. Some of these gave good service and it might be worthwhile explaining why they were removed or replaced.

I have had several items of equipment from Reef Factory including a KH Keeper Plus and dosing pumps. Like many others, it came as a disappointment when the company folded. Although the app is still operational, some items I just could not connect when I changed my broadband provider. To avoid possible future issues, I switched to a D-D KH/PH Manager and added a second D-D H2Ocean P4 Pro dosing pump to the one I had been using for several years.

I did have an algae reactor growing *Chaetomorpha* but it was a bit of a pain having to regularly clean due to the algae build up on its internal light. I also had two fluidisers which contained activated carbon and granular ferric oxide (GFO) but these have also been removed and were replaced by a single Nyos fluidiser which had two compartments which could be used for GFO and carbon. For some time though, this has been used exclusively with polymer biopellets.

When originally set up, the aquarium had two G4 Radion XR15s, attached with brackets. Some time ago I replaced them with G6 Radions and later rescued the old G4 Radions from the garage and suspended the four lights from a hanging bar and discarded the brackets. It looks so much neater than before and the corals enjoyed the extra light. The older G4 Radions have now been replaced by a single D-D Spektrum 150.

Aquascape design

When I set up my aquarium, I had been away from the hobby for a considerable time. The layout of the aquascape was influenced by my previous experience and I would probably change some things if starting again. I will admit to liking a full back-drop of rocks and corals and although I kept rocks a good 'algae magnet' distance away from the aquarium side glass I did build rocks up towards the back glass. I never intended to clean the back glass but it has had the effect of making access to any of the tank base at the back rather difficult! You can see from the photographs that the back wall either has rocks against it or is covered in various corals, especially green star polyps and plating *Montipora* coral. It provides a very natural backdrop but if setting up again, I would try and leave gaps to allow me to siphon the sand at the back. On the plus side, there are so many nooks and crannies for fish to hide in at night that I'm sure it contributes to their overall well-being. When lights are out, everything disappears into a little hiding place and there's not a fish to be seen.

Nutrient and water chemistry control

Over the lifetime of the aquarium, I have employed various ways to control nutrients and water chemistry. Initially it was 10% water changes every one or two weeks. Then, as corals were introduced and grew, a single dosing pump was employed to dose alkalinity. As time has progressed, more dosing pumps have been added. I have used Red Sea solutions, Reef Zlements and Modern Reef products. More recently I concentrated on Reef Zlements solutions for the maintenance of alkalinity,

I've had my 2 ocellaris clowns, *Amphiprion ocellaris* for 8 years now.

Lighting is provided by 1 x D-D Spektrum 150 and 2x EcoTech G6 Pro Radion XR15s

"More recently I concentrated on Reef Zlements solutions for the maintenance of alkalinity, calcium and magnesium using their H2P dosing system in conjunction with the D-D KH/PH Manager."

calcium and magnesium using their H2P dosing system in conjunction with the D-D KH/PH Manager. These also supply trace elements but regular ICP tests have shown where particular trace elements were being consumed at a faster rate. Two bespoke solutions of these are mixed as either anion (A) or cation (C) trace elements and the proportion of each adjusted following Reef Zlements ICP tests which I have done every 6-8 weeks. These use two channels on one of my P4 Pro dosing pumps whilst the remaining two dose amino acids and carbon.

Three channels on the other P4 Pro are used by the KH/PH Manager and the last remaining channel doses lanthanum. This is a very dilute (8%) solution of Modern Reef P- and maintains phosphate levels stable at around the 0.06 ppm mark. It took some time to establish the correct dose rate as I suspect that phosphate was leaching out of rocks etc as the lanthanum was removing it. Nitrates have also been a problem for me (maybe my tank design is to blame!) and over the years I have tried various control methods including adding additional biofilter media to the sump, replacing filter socks with a roller mat, growing *Chaetomorpha* and others. In the past few years, I've met with the most success using NutriFix NP Bio Pellets and nitrates are stable at around 45 ppm level.

I would be happy if these nutrient levels were a bit lower but the corals all seem happy, there are no real algae issues and I only do a 10% water change every two months or so.

The Inhabitants

So that's all the hardware accounted for but what about the inhabitants of my reef. The current stocking list of fish is detailed below along with the time I've had them.

2 ocellaris clowns, *Amphiprion ocellaris* (8 years)
4 Banggai cardinals, *Pterapogon kauderni* (3 years)
Flame angel, *Centropyge loricula* (8 years), were originally a pair but the male died a year ago
Copperband butterfly, *Chelmon rostratus* (6 years)
2 silver belly wrasse, *Halichoeres leucoxanthus* (5 years and 4 years)
4 Springer's damsels, *Chrysiptera springeri* (3 years)
Longnose butterfly, *Forcipiger longirostris* (3 years)
Royal gramma, *Gramma loreto* (2 years)
Powder blue tang, *Acanthurus leucosternon* (7 months)

The most recent addition was the powder blue tang. It's a fish I have always wanted but

shied away from getting one due to their reputation as an 'ich magnet'. When I eventually saw one that had been in the dealer's tank for three weeks and was eating frozen mysis I went for it. It took two or three weeks to fully settle but now eats everything offered and has fattened up considerably. Talking of food, the aquarium feeding regime consists of two feeds a day. The main one consists of frozen mysis and fresh scallops which have been finely chopped and then frozen. An additional feed of flake or pelleted food is usually given in the evening along with nori seaweed or an opened whole mussel held in place with a feeding clip—much enjoyed by the butterfly fish.

Over the aquarium's lifetime other fish have been added. Some of these have simply succumbed, I assume, to old age. I hesitate to say I have never had an outbreak of ich or *Oodinium* as that is surely tempting fate. This has either been pure luck or as a consequence that I have never rushed to add livestock, taken time to choose the healthiest looking specimens I could find and always paid careful attention to possible conflicts which may stress any fish. There have been some unfortunate occurrences though. A third ocellaris clown jumped through a gap in the tank cover whilst on holiday to be discovered by a neighbour feeding the fish. The worst experience was when an algae eating blenny took a dislike to some firefish and literally had one in its jaws, shaking it like a dog shakes a rat. Very upsetting.

It's harder to produce a definitive list of all the invertebrates in the aquarium as apart from those deliberately introduced such as *Nassarius* snails and cleaner shrimps, there are a host of others which just appeared! The two butterflies spend ages poking about the rockwork hunting down copepods and amphipods. There's the usual array of sponges and worms plus *Asterina* starfish which seem to have settled at an acceptable population level.

I won't list all the individual corals (maybe because I'm sure to get some of the names wrong!) but there is a mixture ranging from softies through LPS to SPS species. I have a liking for LPS corals in particular but the accompanying photographs will provide an indication of the different species present. The first introduction was some pulsing *Xenia*. This, not unexpectedly, spread quite a lot but over the years has been pushed back to two small patches by other corals. One of the oldest corals I have is a *Goniopora* which was the size of a golf ball 8 years ago and is now grapefruit sized. I have two regrets as far as introducing corals is concerned.

This relates to introducing corals which are hard to remove. If you're thinking I mean the *Xenia* and green star polyps you'd be wrong. I have some *Pavona* which is an aggressive coral and encrusts

One of the oldest corals I have is a *Goniopora* which was the size of a golf ball 8 years ago and is now grapefruit sized.

itself on rocks so is hard to remove. It's not the most colourful and its long sweeper tentacles prevent anything within reach from thriving. The second is some colonies of olive green *Palythoa* which seem to have an extra-ordinary talent for surviving whatever you throw at them. I've tried physical removal using forceps (keeping the polyps under water at all times to avoid exposure to palytoxin) and dosing with treatments for *Aiptasia* anemones. No matter how much I try to kill them they still bounce back.

Overall, I do feel that the tank is very successful which I measure by the fact that many of my fish and corals have been with me for a long time. Some corals have grown so well that they need pruning back and where ever possible I've tried to trade them with my local fish shop or given away to fellow reefers. When I compare my current aquarium to the ones that I kept 50 years ago there is no comparison—the hobby has made unimaginable advances over this time. And the most rewarding aspect, apart from that little slice of the ocean in the living room, is that there is always something new to learn in this hobby.

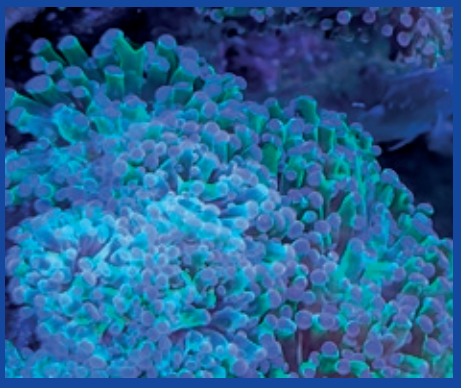
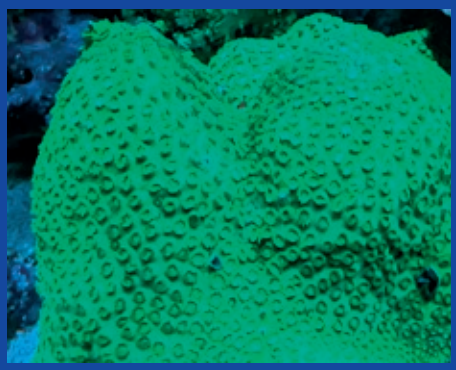


















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