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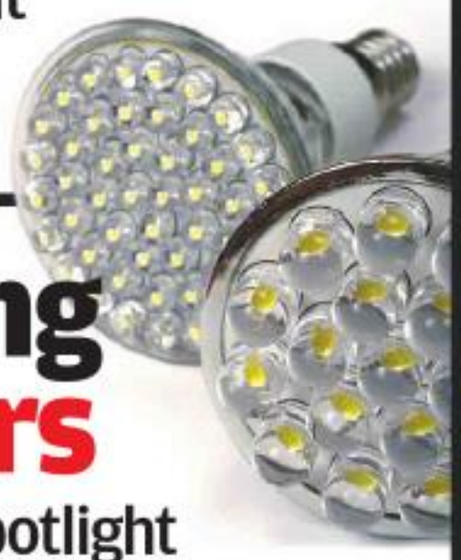
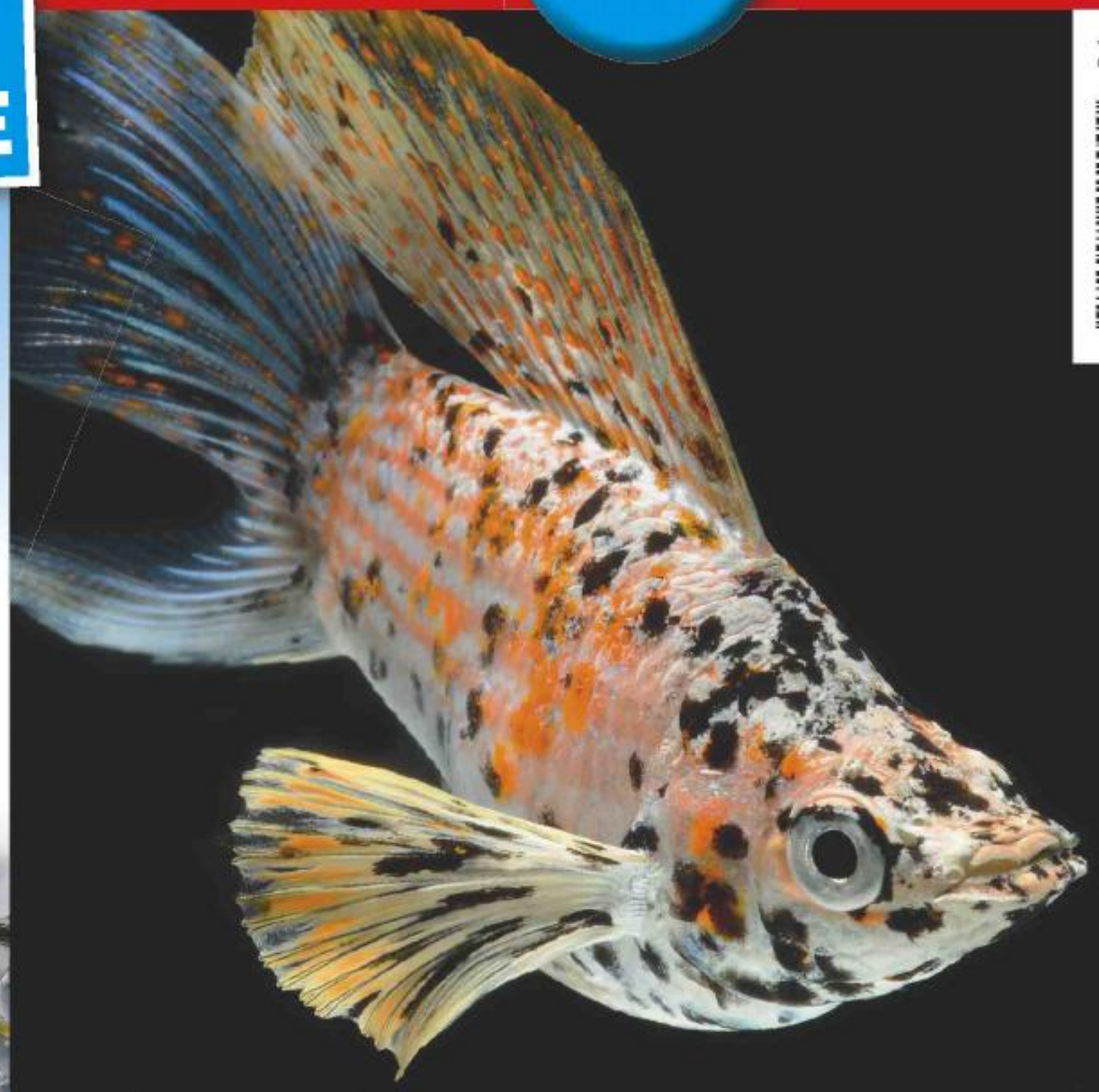


Lighting matters

LEDs in the spotlight

Tank doctor

Recognising early signs of illness



Magnificent mollies

Learn more about these livebearers

Discover the world of killifish

HOW THEY CAN COME BACK FROM THE DEAD

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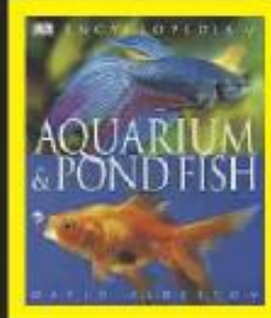


David has kept fish for many years, and his books include the *Encyclopaedia of Aquarium & Pond Fish* (Dorling Kindersley, £16.99) - a comprehensive guide to the care of over 800 species. His website can be found at www.petinfoclub.com

Welcome to the latest issue of *Popular Fish Keeping!* If you're new to the hobby, you may already be dazzled by the range of fish on offer at local aquatic outlets near you. But there is one group, known as killfish, that you will not find stocked in any numbers there, if at all. Killifish are still one of the best-kept secrets in the fish keeping, in spite of being fascinating and relatively easy to keep!

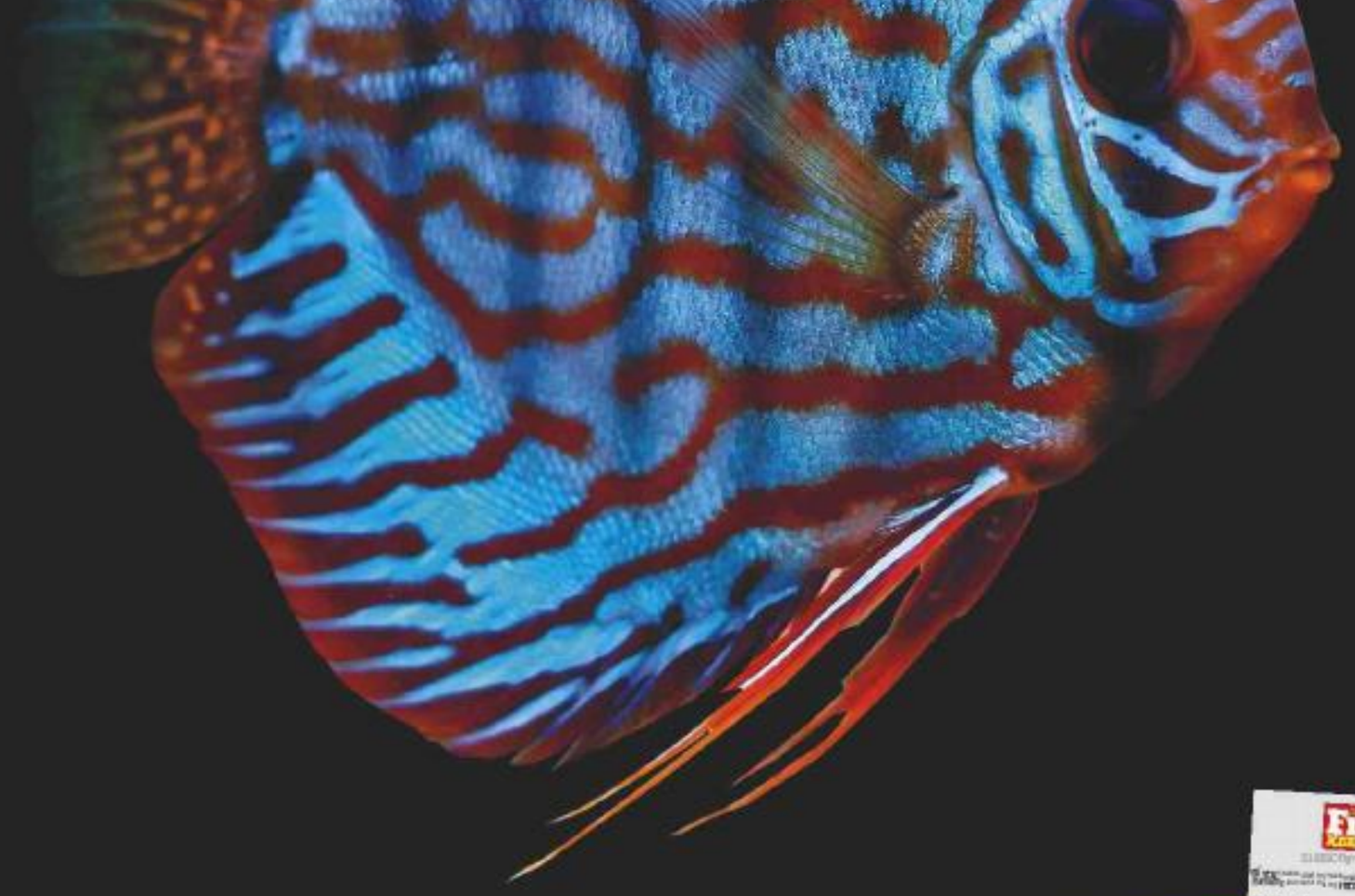
In order to raise their profile therefore, we have teamed up with the British Killifish Association (BKA) to provide detailed information about these stunningly attractive small fish, starting in this issue. Should you be inspired to take the plunge, there is also a special offer that will allow you to join the BKA at half price, and have direct access to breeders, in order to obtain stock.

If you live in a remote part of the country, and normally have to travel miles to your local aquatic shop, then killifish could be ideal for you. This is because rather than going to purchase live fish, you can simply order their eggs, choosing from the wide range of species kept by fellow BKA members, and have these sent directly to you to hatch at home.

There is also a fascinating article about zebra danios in this issue, which rank as a one of the most common choices for a community tank. I guarantee that you will never see them in the same light again after reading this article though! Equally, prepare to be amazed by our selection of some of the stunning shrimp that are now available.

Our regular contributor on these colourful crustaceans and their care, Lucas Witte-Vermeulen of Sharnbrook Shrimp, has just opened the country's first-ever specialist shrimp retail outlet, located in Rushden, Northamptonshire. So if you're in the area, do pop in and say hello!

There's also experienced advice on aquarium lighting, fish health and much more to enjoy in this issue, plus news about a very rare aquarium breeding success with a popular fish from a group that faces an increasingly uncertain future in the wild. And as always though, if you have any particular topics that you'd like to see covered in the future, just email me and I'll try to oblige!



David Alderton, Editor
pf.ed@kelsey.co.uk

THANKS TO WWW.SHUTTERSTOCK.COM FOR PHOTOGRAPHY

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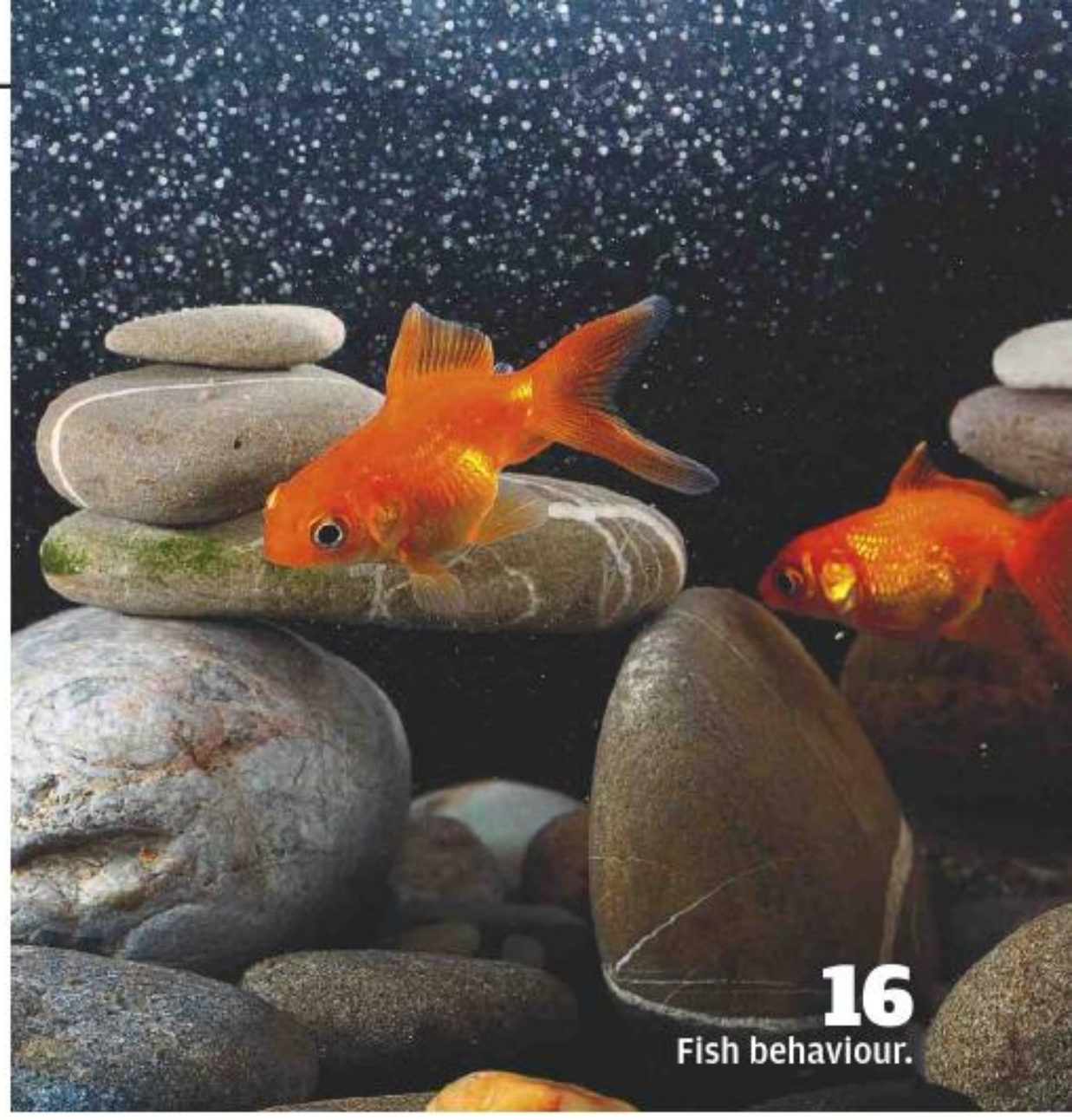

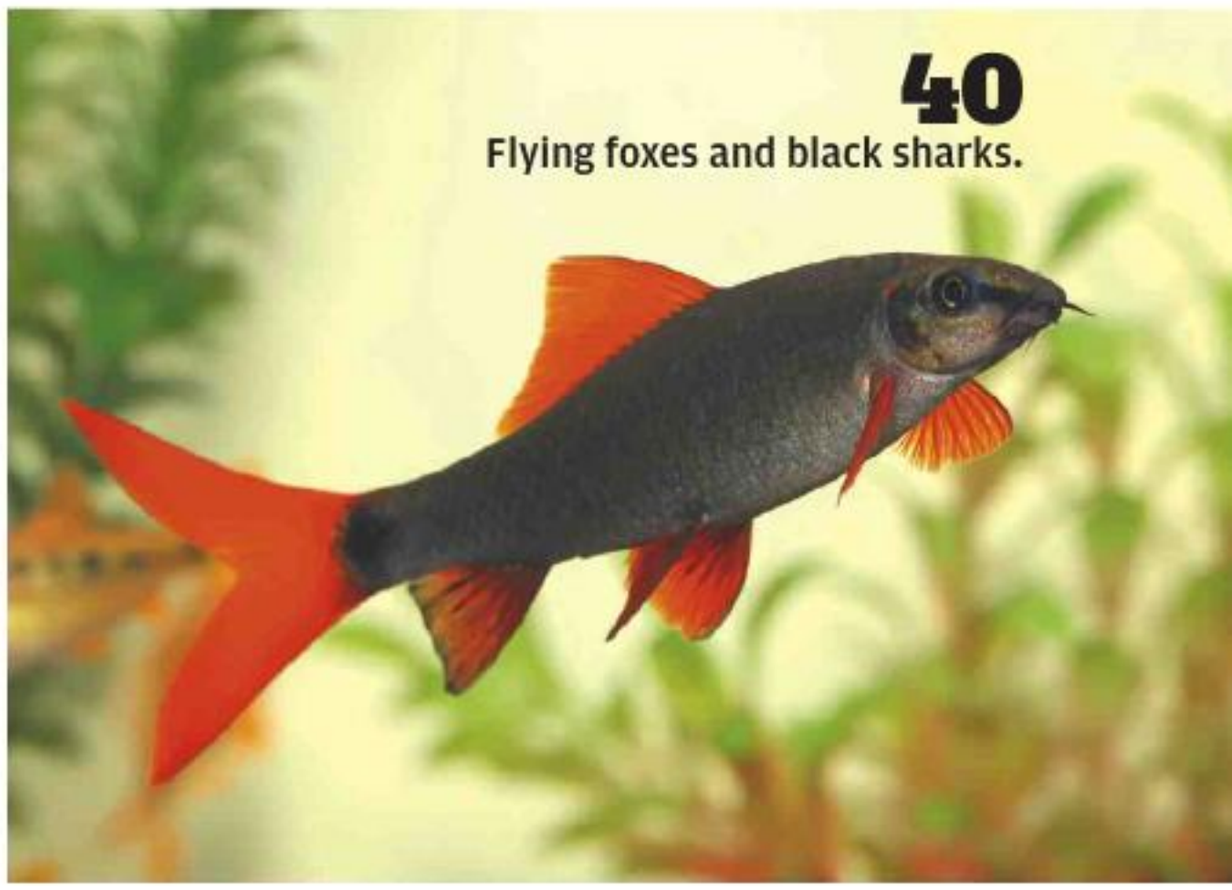

Did you know?

You can buy *Popular Fish Keeping* in a digital form - and get our back issues too - through **Pocketmags.com** with the digital version being available on Apple iOS, Android, Playbook and Windows 8. Go to **http://sub.sc/wEJRN for full details**.

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Do it now!

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Keep up-to-date with events in the world of aquatics.

Share your views and opinions by Emailing us: pf.ed@kelsey.co.uk

Top marks for FishScience aquarium foods!

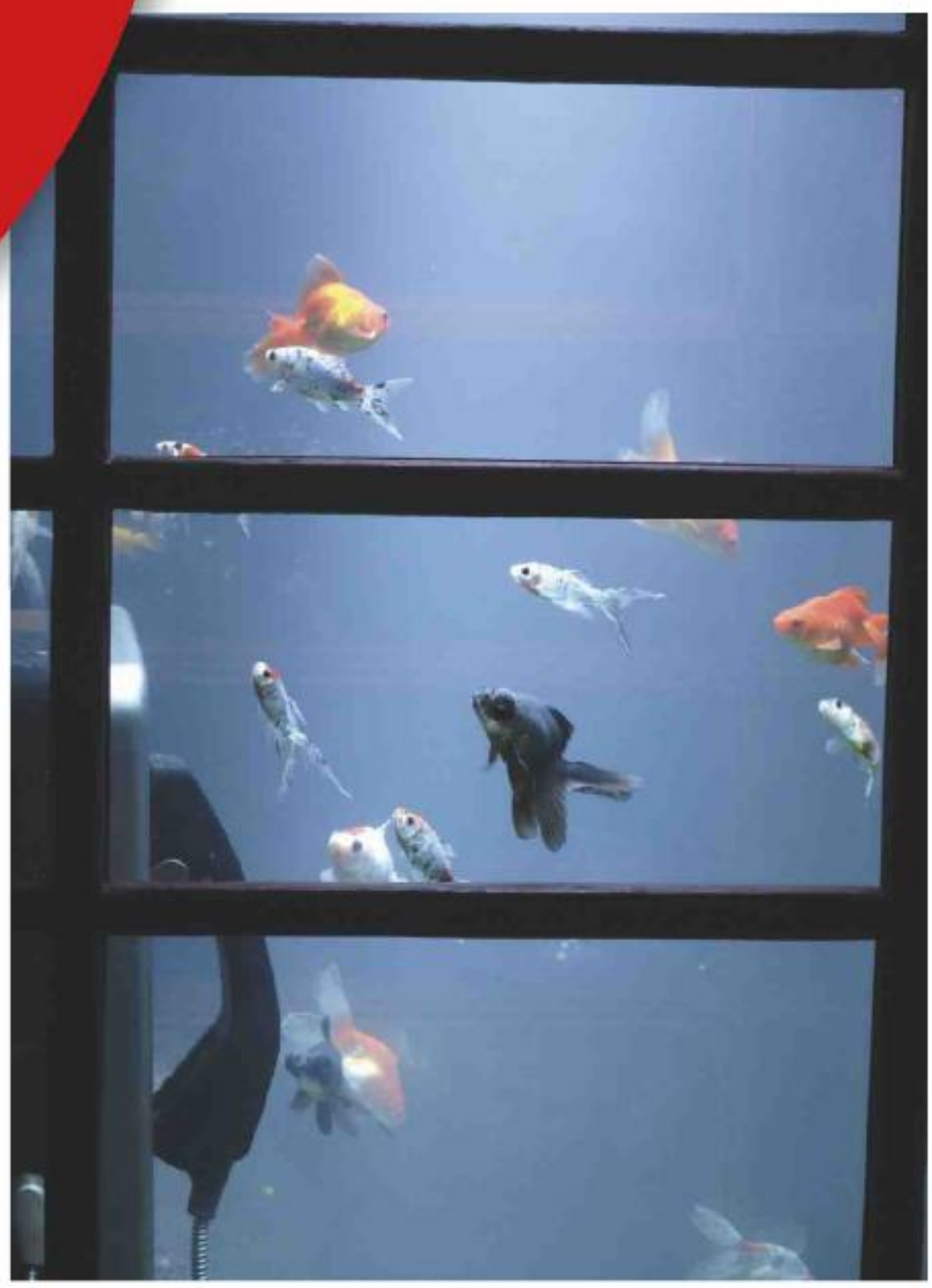
The range of FishScience aquarium foods.

New fish foods from FishScience Ltd were trialed by members of the Federation of British Aquatic Societies (FBAS) prior to being launched at the recent AQUA 2013 exhibition. The foods, which included FishScience Tropical Flake, Tropical Granules and Goldfish Bites were used over a period of up to two months by experienced aquarists from the FBAS.

The fish keepers were then asked to assess the foods that they had used, based on the following criteria: acceptance by the fish, colour enhancement, waste production and overall performance. The foods received an impressive 9.5 out of 10 as their overall rating.

Dr David Pool, a long-standing fish keeper himself, who developed the FishScience range of food, explains: "The foods were formulated to provide excellent nutrition for aquarium fish. Getting such superb scores from key members of the FBAS - people who really know about keeping top quality fish - is great news and demonstrates the high quality of the products."

* Further information on the FishScience range of foods is available from www.fishscience.co.uk . They are available from aquatic stores throughout the UK and Eire. For further information on the FBAS and to find a fish keeping society near you, visit www.FBAS.co.uk



The French tank that made a splash

This strange tank is an art installation mounted in the centre of Durham, in the north-east of England, by French artist Benedetto Bufalino and lighting designer Benoit Deseille. Created from an old red phone box, the exhibit is simply called "Aquarium" and was one of the most popular parts of the city's recent "Lumiere" light festival, *reports Victoria Neblik.*

"Aquarium" is a British version of an idea that Bufalino and Deseille first tried in 2007 at Lyon's festival of lights and which they have subsequently adapted for other locations. Speaking about the project, Bufalino, 31, explains: "The idea was that everyone has mobile phones, but rather than taking phone booths away, why not keep them and fill them with water to turn them into aquariums?"

Lighting specialist Benoit Deseille adds: "The French phone booth was exhibited in 2007... now it is a great opportunity to bring it over to the UK, but using a red English phone booth."

The aquarium is a temporary home to several varieties of goldfish, including black moors and some veiltails. This is not the first time this artist has made a home for animals out of urban items - previous projects have included turning a French police car into a chicken coop! Nonetheless, it is probably one of the stranger fish tanks ever produced: as the French say: "Chacun à son gout", meaning "each to his own"!

Are you launching new aquatic products? Want to let our readers know?
Drop us an email to: pf.ed@kelsey.co.uk

Here, RAP Director Trond Larsen stands in the middle of the formerly dry camp.
PHOTO © TROND LARSEN.

New fish found

A recent expedition to the northern South American country of Suriname, organised by Conservation International, has pushed deep into one of the last pristine areas of rainforest left on the planet, and made some remarkable finds.

The team surveyed four sites in the upper Palumeu River watershed, going from low floodplains to isolated mountain peaks. At one stage, their camp was flooded out, thanks to unusually strong and long-lasting rain that caused the river to flood its banks.

The team collected data on water quality and an astonishing total of 1,378 species, including plants, ants, beetles, fish, amphibians, birds and mammals. The results show high quality water conditions overall, although some samples contained mercury above safe levels for human consumption, despite the fact that there is no upstream mining.

"The mercury is probably blowing in from mining and industrial activities in neighbouring countries. This demonstrates that even remote places are interconnected and susceptible to activities in other countries," explains Dr. Larsen. He works as a tropical ecologist and Director of the Rapid Assessment Program (RAP) at Conservation International, which has sometimes been described as operating like a "SWAT" team for science, carrying out urgent investigations.

Amongst the provisional list of some 60 new species that the expedition discovered were no less than 11 different types of fish. These included a potentially new form of the head-and-taillight tetra that is well known in the aquarium hobby. It has been christened *Hemigrammus aff. ocellifer.*

ABOVE The newly-discovered close relative of the head-and-taillight tetra
PHOTO © TROND LARSEN

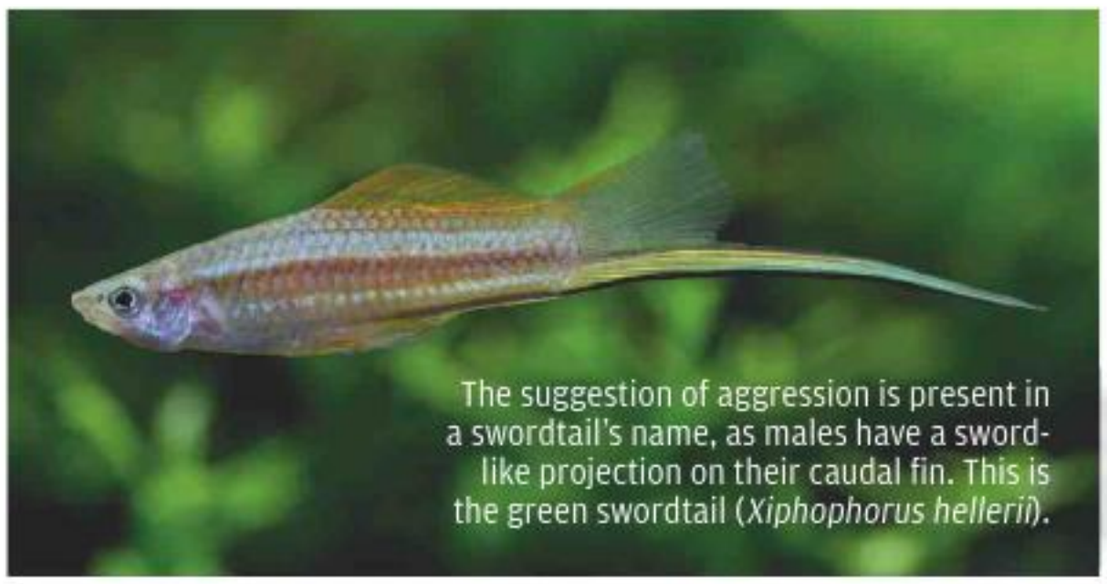
BELOW A recognised example of this species
(SOURCE PD).

An interesting catfish species (*Parotocinclus sp.*), which is potentially new to science, was collected in a tributary of he Upper Palumeu River. It has an unusual pigmentation pattern, similar to *Microglanis* species. Other new species of fish included a South American darter and a three barbeled catfish.

Fish were diverse and plentiful at the various study sites, which was good news. They included many large fish that serve as an important source of food for local people.

The new *Parotocinclus* species, found in Suriname.
PHOTO © SANDRA J. RAREDON, SMITHSONIAN INSTITUTION.

Conflicts in fish – study reveals that size isn't everything



The suggestion of aggression is present in a swordtail's name, as males have a sword-like projection on their caudal fin. This is the green swordtail (*Xiphophorus helleri*).

When predicting the outcome of a fight, the big guy doesn't always win, according to new research involving fish. Scientists at the University of Exeter in the UK and Texas A&M University in the USA found that when fish fight over food, it is personality, rather than size, that determines whether they will be victorious. The findings suggest that when resources are in short supply, personality traits such as aggression could be more important than strength when it comes to survival.

The study, published in the journal *Behavioral Ecology and Sociobiology*, revealed that small fish were able to do well in contests for food against larger fish provided they were aggressive. Regardless of their initial size, it was the fish that tended to display consistently aggressive behaviour - or personalities - that repeatedly won food and therefore put on weight.

Dr Alastair Wilson from Biosciences at the University of Exeter said: "We wondered if we were witnessing a form of Napoleonic or small man syndrome! Certainly our study indicates that small fish with an aggressive personalities are capable of defeating their larger, more passive counterparts when it comes to fights over food. The research suggests that personality can have far reaching implications for life and survival."

ABOVE A sheepshead swordtail - the species used in this study.
PHOTO COURTESY OF THE UNIVERSITY OF EXETER.

Sheepshead swordtails (*Xiphophorus birchmanni*) were placed in pairs in a tank, food was added and their behaviour was captured on film. The feeding contest trials were carried out with both male and female fish. The researchers found that while males regularly attacked their opponent to win the food, females were much less aggressive and rarely acted in this way.

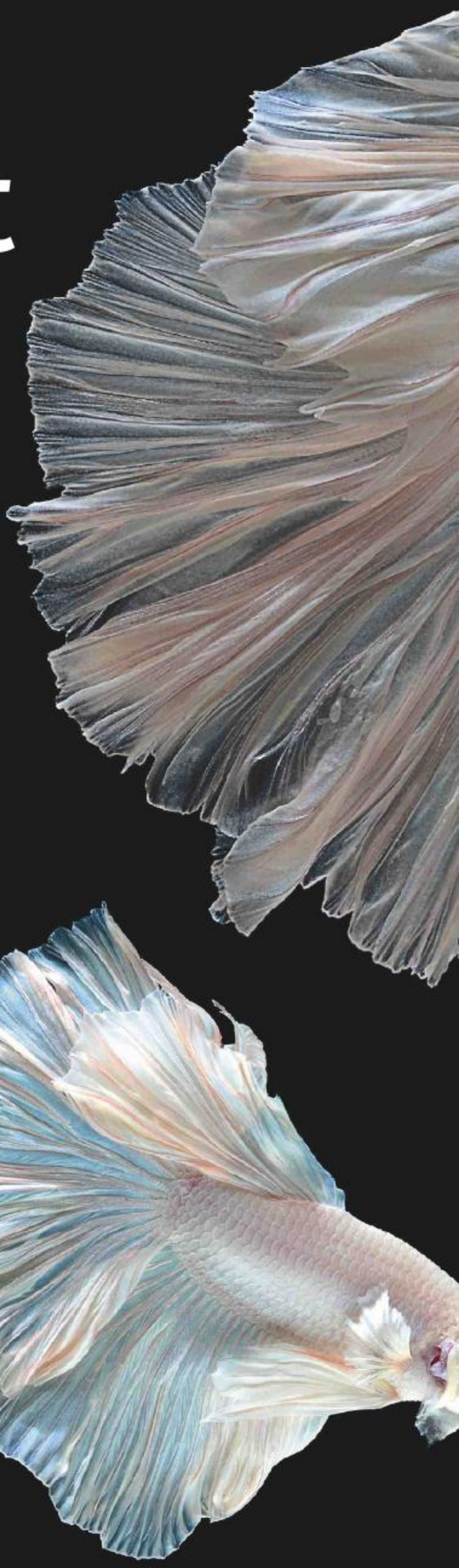
In animals, personality is considered to be behaviour that is repeatedly observed under certain conditions. Major aspects of personality such as shyness or aggressiveness have previously been characterised and are thought to have important ecological significance.

There is also evidence to suggest that certain aspects of personality can be inherited. Further studies on whether winning food through aggression could ultimately improve reproductive success will shed light on the heritability of personality traits.

A balletic betta caught in action

This amazing sequence of photographs featuring a male Siamese fighting fish or betta (*Betta splendens*) is so stunning that it is quite easy to forget that the fish's movements were captured underwater.

Thai photographer **Visarute Angkatavanich**, who is based in Bangkok, first became fascinated with bettas when he visited a local market where many of these striking fish were on sale. Since then, he has built up a stunning collection of photographs showing them in action, swimming through the water.



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A betta guide

These beautiful fish are easy to keep, provided that you follow a few simple rules. Females can be easily recognised by their much less elaborate fins.

Cost

Males may cost up to £10, with females usually about £2 cheaper although this depends on the variety. Highly prized specimens can sell for much more.

Lifespan

Quite short - up to 2 years.

Space requirements

Siamese fighting fish are small, only growing to little more than 2in (5cm) long. Their housing needs are quite modest, being traditionally kept in their Thai homeland in glass jars. A male will thrive in a small, relatively shallow tank, although he can also be included in a community aquarium of south-east Asian fish.

Care requirements

The water temperature needs to be 24-28°C (75-82°F), with the water being soft and slightly acidic, having a pH of around 6.2. Cover the surface with floating plants, and the filtration must be gentle, as these fish do not like turbulent water.

Temperament

Never, ever mix males together. They will fight to the death. You can see how aggressive they are simply by leaving a mirror alongside the aquarium for a short time. Once it spots its reflection, the male will repeatedly try to attack his perceived rival. Avoid tank mates with similar colouration too, as they may attacked.

Varieties

Colours can vary from white variety, known as plakat, via shades of red and crimson to hues of blue and violet and through to black. There are also different fin types too, such as the half-moon, with its rounded tail fin.

History

Siamese fighting fish were developed in Thailand, being first bred there over 400 years ago. Strains were carefully nurtured, with wild bettas from all over the country being used in their development. No-one is really sure what the original wild form looked like - the best guess is that it was dark red, with some bluish streaking on the body. Males were bred as fighting fish. They were placed together and huge sums could be wagered on the outcome as the rivals then fought each other in short but brutal contests. Now however, they are kept for show purposes, being judged on their appearance.

Did you know?

The male builds a bubblenest, which he will anchor to floating plants. He does this by spitting out air-filled bubbles of mucus. The female is enticed to mate underneath the structure. Her eggs, which are full of oil, will float up to the water's surface and remain trapped under the bubblenest. The male then guards this and will continue to watch over the young for several days after they have hatched.

Likely illnesses

Damage to the fins occurs if these fish are housed with companions that will nip their long trailing fins, or if water conditions are poor. In either case, a fungal infection can then follow. Remarkably though, if treated in time and its housing conditions are improved, then the fish's damaged fins can regenerate.

Talking fish

A red-tailed catfish. One of Darren's favourite fish.

Susie Kearley recently talked with a group of experienced fish keepers about the scope of the hobby. Here she reveals what attracted them to it, as well as their thoughts and tips.

How did you all first get into fish keeping and breeding?

Allan: When I was a small child, I spent time with carers who had a back room full of fish tanks. I was fascinated by the fish swimming around, and spent all my time in there just watching the fish swimming to and fro. The breeding side came much later – it was the fascination of watching them that stayed with me from an early age.

Allan Finnigan is a keen fish breeder and exhibitor from Leicester. He's been showing for 30 years and has lots of experience in terms of both exhibiting fish and breeding them. He's involved in the Federation of British Aquatic Societies (FBAS), showing at their events, and providing photographs for their website.

Darren: I started keeping fish when I was around 10 years old and living in Scotland. My uncle gave me a fish tank and I've never looked back. It's a very addictive hobby and it wasn't long before I was totally hooked!

By the time I was about 14 or 15, I had several tanks dotted around my parents' house. They were in my bedroom, the kitchen, the hall, and the living room. I kept large cichlids, such as oscars, jaguars and tilapia. I also kept angelfish, a couple of eels and a red-tailed catfish, which was one of my favourites. The catfish was just 5cm (2in) when I got it, but it grew to about 69cm (27in) before I had to move it on to a public aquarium.

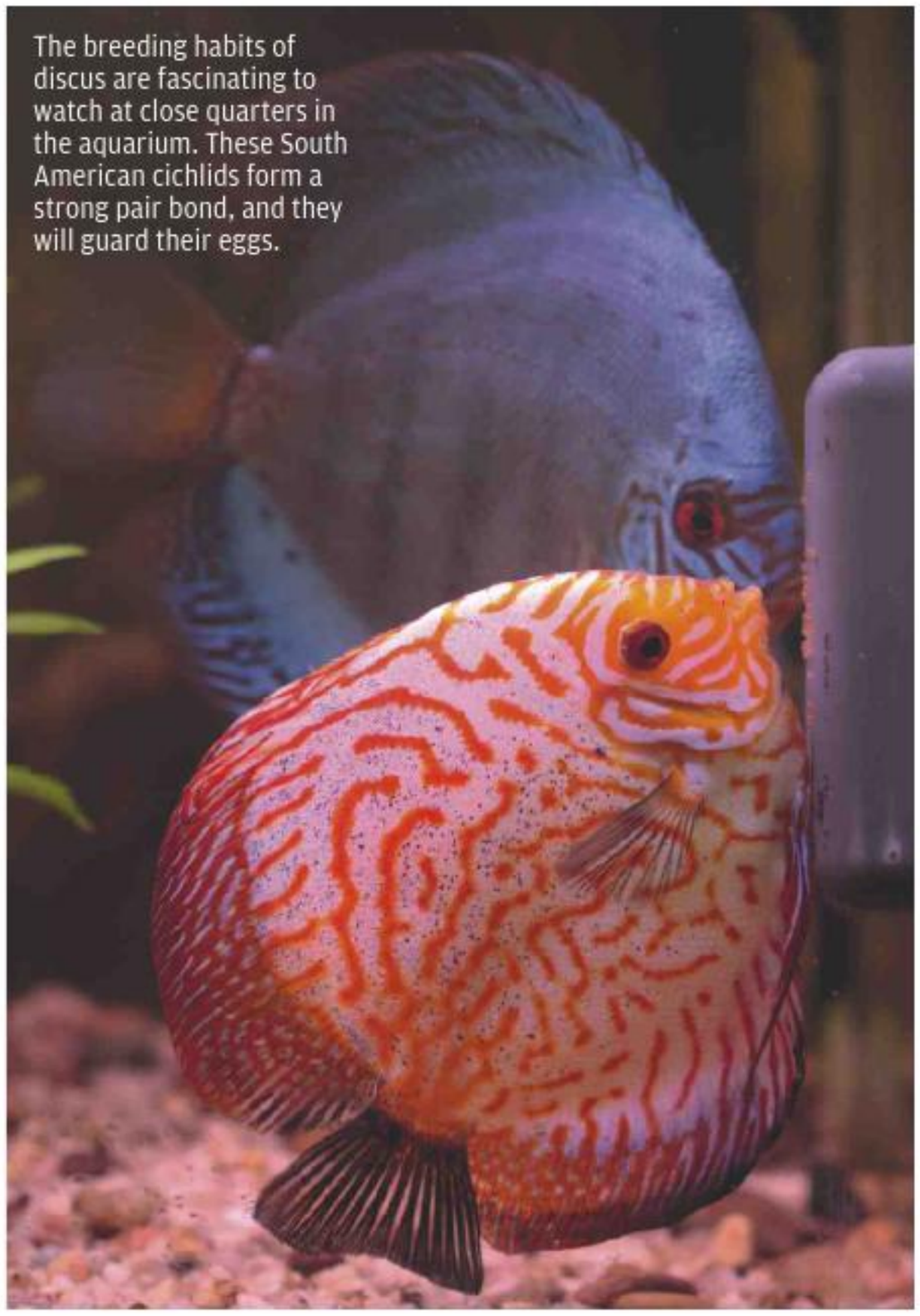
I also kept a couple of silver arowana. They were my pride and joy. They also outgrew anything I could fit in the house so they went to south Queensferry Deep Sea World and are still there today in their Amazon tank. Always be aware of how big your fish can grow at the outset, because it becomes much more expensive to house them as they grow larger, and ultimately, you may not find an aquarium today that wants to take them on.

Over the years, I have also kept a large pacu, uaru and stingray. I started off with South American fish and branched out a little, but kept returning to species from this continent.

Darren Thomson was originally from a village just outside Glasgow, but today lives on the Gold Coast in Queensland, Australia. He is a member of the Queensland Aquarium Forum.

Finn Ellis is a keen fish keeper from northern New South Wales in Australia. He is not a member of a fish-keeping club, but he does contribute to a few of the larger aquarium forums in his region.

Finn: When I was about five years old, I got my first fish tank. It had a few guppies and snails in it. I was fascinated by the fish



The breeding habits of discus are fascinating to watch at close quarters in the aquarium. These South American cichlids form a strong pair bond, and they will guard their eggs.

An attractively planted tank housing a pair of Darren's breeding discus.
PHOTO COURTESY DARREN THOMSON

Jaguar cichlid – a Central American species, capable of growing to 35cm (14in). These fish are predatory, and so any companions need to be chosen with great care.

and gradually got more and more interested in the hobby until I took the next logical step, which was to start breeding them.

What species or varieties of fish do you breed?

Allan: I breed a lot of barbs and livebearers, along with a few oddball varieties. I love catfish and oddballs. I try to breed the harder varieties, because I know a lot about the different species and there's obviously an attraction in having fish that are more difficult to breed and unusual to show. It provides a great sense of achievement and satisfaction.

Darren: At the moment I have two pairs of breeding discus, and I'm also breeding bronze corydoras, albino corydoras, koi angelfish, silver angels, jewel cichlids, and hoplosternum catfish.

I breed for a hobby and also sell some of the young to contribute towards the running costs of all my tanks, such as the water and electricity. I love the challenge of breeding different fish and changing the conditions in the tank to trigger breeding. I adjust the pH levels and alter the water temperature for example, for conditioning purposes, reflecting what happens in the wild.

It's then great to see my baby discus feed from their parents, nibbling the mucus off their flanks. Other fish are great parents and guard their young very well but discus are just so graceful. They are usually such fantastic parents when they are mature enough and settled, but you need to be prepared for a few disappointments at the outset.

Finn: I specialise in flowerhorn breeding. These fish are a hybrid created by the cross-breeding of two Central American cichlids, and are quite recent in origin, dating back to the early 1990s. They were first developed in Asia where the market for them really took off, especially in Malaysia, and they have since been bred and exported so that now they are available in most countries around the world.

In Australia we have a limited supply and quality due to strict importation laws. This means that breeders are working very hard to produce quality fish. I have never shown fish though, because flowerhorns, as artificially-created hybrids, are a very delicate subject amongst some of the purists, and they are usually not allowed to be shown.

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RIGHT A hoplosternum catfish. These fish originate from parts of Central and South America, and typically grow no larger than 15cm (6in) long. Their breeding habits are fascinating. Pairs construct a bubblenest for their eggs at the water's surface, like Siamese fighting fish.

Flowerhorn cichlids come in a wide range of colours and patterns. These hybrid cichlids are always colourful fish, as shown here.

What has been your proudest moment and what keeps you interested in the hobby?

Darren: When I was about 16, I set up a shed behind my mum's house, housing all the 35 tanks that I had gathered. I welded all the frames in place, then insulated and heated the shed for the tanks. I was very pleased with the result. That's when I moved into breeding different fish. I started with oscars and angels, and my tilapia were constantly breeding.

After a while, I discovered a love of discus and it all changed. Nearly everything else went and as I started my collection of these wonderful fish, I had six pairs of discus on the go. I filled up the shed, leaving my mum with plenty of work, when it came to water changes and feeding as I was working full time!

Then I moved into my own home, sold the breeding set up, got myself a salt water tank and built a 6.7m (22ft) Japanese koi pond in my back garden. That kept me going until I moved to Australia. I can't keep koi in Queensland or I would probably have another pond.

Having settled here in Australia, I didn't give aquatics much thought at first. But after four and a half years, I decided to get a small aquarium set up in the house. Almost immediately, the bug bit me again! Within eight weeks, I had five tanks running. A month later, there were 18 on the go. I now have a rack system for 14 tanks and a few others for growing on young fish. I also have a discus show tank.

Finn: My proudest moments have been when people started to notice me in the fishkeeping world and asked how my strains were going. The number of new fish and new creations that are available keeps me interested in the hobby. One day, I hope to have a monster tank with large predatory fish inside! I do sell some of the fish that I breed, but I also keep the best to create my future breeding pairs, improving the overall quality of my fish, in terms of their appearance. I sell to the general public and to my fish keeping friends.

Tell me about your tank styling

Allan: The tanks are set up according to their style of breeding, so it depends on whether the fish is an egg scatterer, livebearer, egg layer or mouth-brooder. I only have three tanks in the house. The rest are all outside in two fish houses. I try to make the tanks indoors look aesthetically pleasing, but I don't have to be quite so picky with the ones outside in the fish houses.

Finn: My tank styling is very minimalistic. I only use what I have to in tanks. This includes gravel, filters,

Darren's tanks waiting to be set up.

The tanks once they were set up. The flowerpots (which must be free from any chemical sprays) can act both as retreats and spawning sites.

Malawi cichlids. These colourful fish are a great choice if you live in a hard water area.

A Zhen Zhu flowerhorn displaying a black tail mutation.
PHOTO COURTESY FINN ELLIS

heaters and a few interactive pieces such as driftwood or rocks for the fish to enjoy or shelter behind. I absolutely hate fake plants!

Have you got any tips for people who are new to fish keeping?

Allan: As with all hobbies, fish keeping and breeding is what you make of it. The satisfaction of getting a tank and everything set up correctly in order to breed a difficult type of fish is pleasure enough. After all, it's ultimately down to the fish themselves rather than you!

If you're thinking of keeping or breeding fish, start by finding out what your local water is like. In Leicester our water is hard, so it's ideal for Malawi cichlids. Once you've established the characteristics of your water, look for what fish you can keep in that water without altering it too much. This makes things much simpler, particularly if you have to travel regularly or work some distance away, and someone else – who may not be so enthusiastic as you are! – has to take over their care on a temporary basis.

If you're interested in fish-tank styling, or showing in a competitive environment, look in a book or go on line and see for yourself where that fish comes from and design your tank around that. Get a good quality show tank and make sure the fish are used to being in it, as a starting point.

Reading about the subject is really beneficial. I have built up a large book collection on the topic over the past 30 years, and I refer to lots of websites, but one of the most useful is the Federation of British Aquatic Societies' website at www.fbas.co.uk

Darren: I would recommend fish keeping to people of any age. It's such a relaxing hobby and it can be a 30 minute task once a week - or a full-time job! Having a tank in the house or office changes the whole feeling of a room.

For new fish keepers, I would always say do your research on the particular fish that you plan to keep first. It helps get your tank and conditions right. Don't be put off by negative reports on how some fish need expert care. If you follow the simple rules of good, clean water that suits the fish, along with proper filtration and suitable lighting, you should not encounter too many difficulties. Check also on their dietary needs though, as some fish are easier to feed than others. This can apply particularly when attempting to breed them and rearing the young successfully.

The Queensland Aquarium Forum is a great website where people share information about aquatics. It contains information that is helpful to people all over the world. Members all support each other to get the most out of the hobby. There are a few groups on Facebook that I'm a member of too - they are great fish keeping communities.

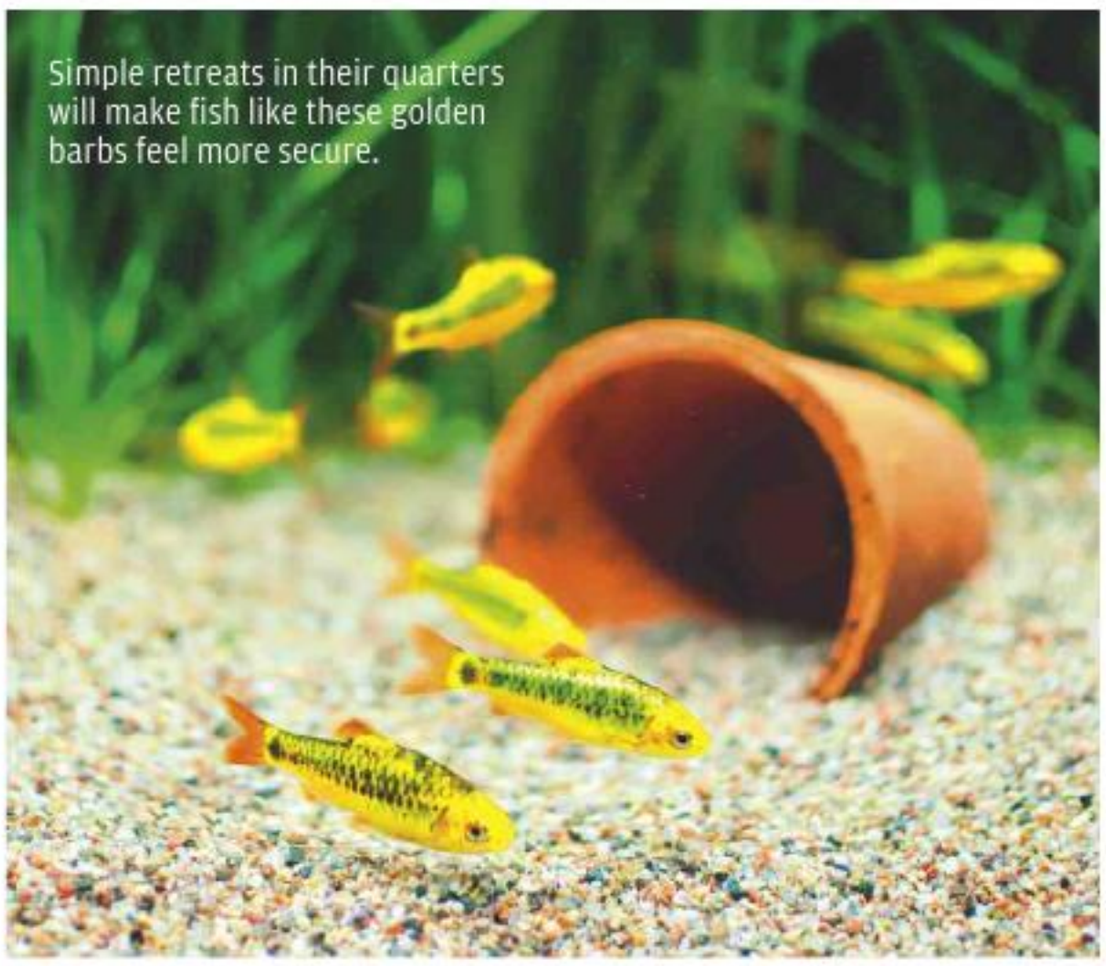
Finn: Before you decide to keep fish, make sure you know how to care properly for the fish that you will be buying, and never buy on impulse. Otherwise, you are likely to end up with a disaster on your hands, with fish dying through ignorance. Once you know what you're doing though, fish-keeping is an awesome hobby and I'm amazed that more people aren't interested in it. I often think this is because they've never considered it as a hobby. Beware, because it does become addictive though!

How to make your fish feel more at home

Have you thought about adjusting your aquarium layout to improve the well-being of your fish? The evidence is clear. Not only is a naturalistic setting more attractive in any case, it also brings a host of benefits for the fish themselves, some of which simply would not be suspected. **Dr Julia Mueller-Paul** provides advice, based on the results of the latest scientific studies.

Some freshwater fish spend their lives in comparatively open waters but the natural environment of most species is extremely varied and rich in its make-up. It is likely to contain a range of plants, stones, sand, and trapped wood, providing a range of feeding grounds, nesting sites, hiding places, and territories comprised of different areas.

Fish tend to use all these localities and incorporate them into their natural behaviour.



Simple retreats in their quarters will make fish like these golden barbs feel more secure.

So it is easy to understand that the absence of such variety would impact on the behaviour and welfare of fish in aquarium surroundings.

It is therefore essential for any conscientious fish keeper to provide environments that are most appropriate for the species that they keep, enabling their fish to live in the most natural way. Fish will thrive best when they are able to perform the whole spectrum of their normal behaviours in appropriate environments. The term coined to describe improvements in animal enclosures for this purpose is "environmental enrichment".

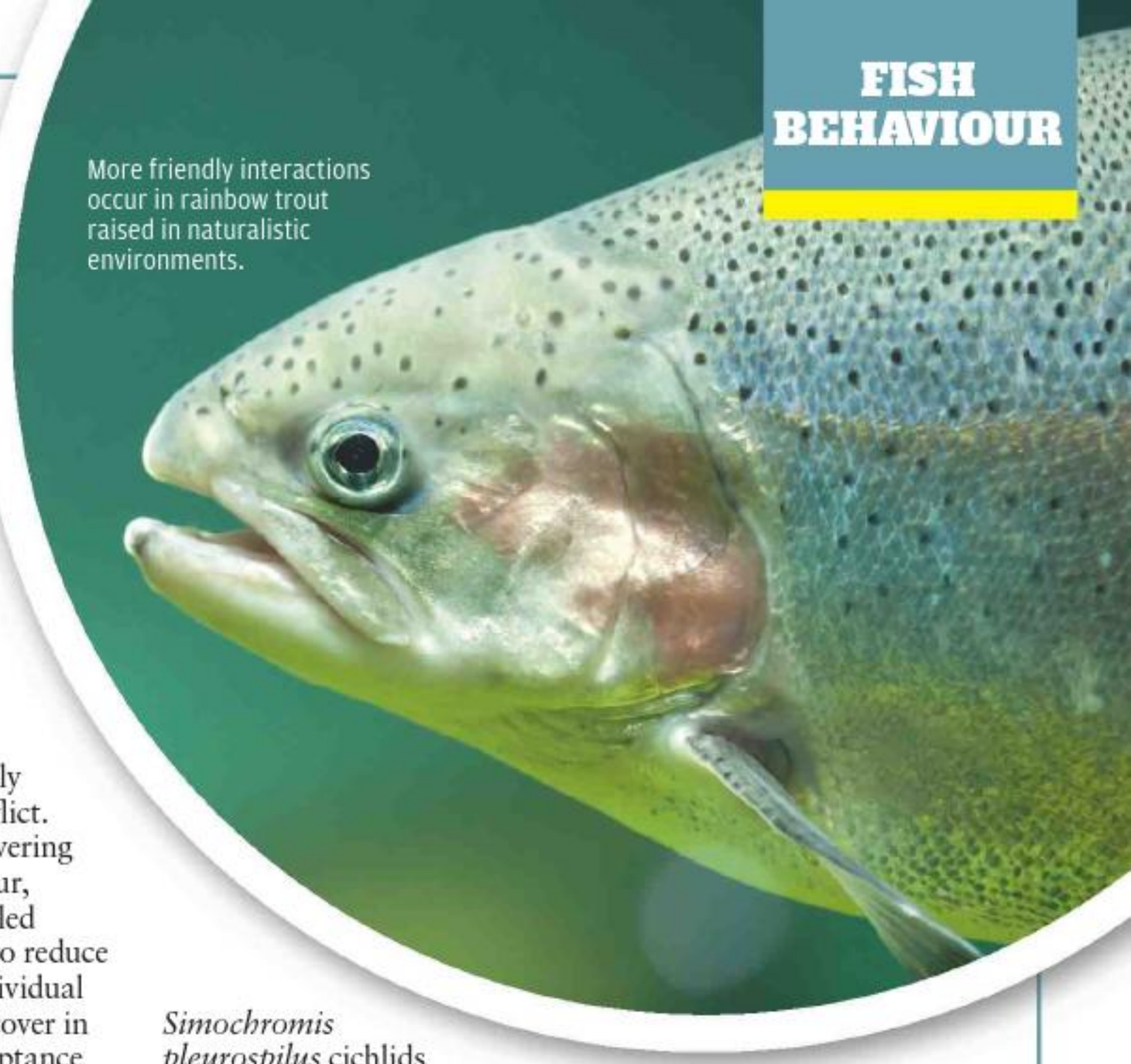
Habitat changes

Appropriately enriched and varied aquatic environments are one aspect of fish husbandry that can greatly increase the welfare of pet fish. It can also make their management easier too, by reducing the likelihood of conflicts, injuries and illnesses. Possible ways of enriching an aquarium include the introduction of more natural, variable underwater structures such as plants, rocks, hiding places and the use of species-appropriate substrates.

But this does not just end with the habitat itself. Think of the way that fish feed in the wild. Then aim to present food in a way that encourages them to forage in the aquarium, encouraging the fish to look for their food. Try feeding them a little at a time, offering this in different areas of the tank.

Levels of aggression altered

A number of studies have now shown how worthwhile it is to put some effort into designing interesting, enriched environments for fish. For example, rainbow trout (*Oncorhynchus mykiss*) fry reared in this type of set-up were shown to be more



More friendly interactions occur in rainbow trout raised in naturalistic environments.

"additional cover in the tank assisted acceptance of close neighbours, and served to reduce the risk of potential conflict"

socially adaptable than those raised in barren environments.

The interactions between fish raised in enriched environments containing an interesting underwater landscape with adequate substrate and overhead cover, as well as food being supplied in a natural manner underwater, were similar to those of fish raised in natural environments. These fish were less aggressive and more accepting of others in their social group than those raised in barren aquariums.

However, while the deprived fish were more aggressive, they were also ultimately less successful at defending their territories when tested in a natural environment. They also only achieved low positions in social dominance rankings when living in a group if placed together in the company of fish coming from enriched environments.

A study on pearl cichlids (*Geophagus brasiliensis*) confirmed the findings of reduced aggression. While the researchers expected that the fish would fight more fiercely to defend a more valuable, enriched territory, the results showed exactly the opposite.

The enriched environment reduced aggression towards intruders so far that these cichlids would often live closely together without conflict. In addition to this lowering of aggressive behaviour, the enriched, plant-filled surroundings served to reduce visibility between individual fish. This additional cover in the tank assisted acceptance of close neighbours, and served to reduce the risk of potential conflict.

Adapting and learning

Cod (*Gadus morhua*) were tested on their ability to adapt to different situations when swimming in a shoal. Those coming from impoverished aquariums showed the same behaviour pattern in every situation, while those from more natural environments matched their behaviour to the situation and were able to vary and adapt their behaviour as required.

This shows that fish that living in environments that do not stimulate their learning abilities are less adaptable in terms of behaviour. The learnt benefits of even very small environmental variations were also demonstrated in another study, involving juvenile *Simochromis pleurospilus* cichlids from Lake Tanganyika in Africa's Rift Valley. In this case, even simple variations in their feeding habits were reflected in greater cognitive achievements that could be observed for at least a year after the changes had taken place, reflecting their lasting impact on the memory of these fish.

Reductions in anxiety and stress

Another study examined the effect that the environment in which fish live has on their overall levels of anxiety. Zebra danios (*Danio rerio*) were kept either in an enriched aquarium containing plants, hiding places, rocks and a natural floor substrate, or in a barren aquarium containing none of these features. The anxiety levels of the fish were subsequently tested by placing them in an aquarium in which one half was black, and the other was white.

Natural hiding responses which are a reflection of anxiety would lead the fish to spend more time in the black half of the aquarium whereas confident, explorative behaviour leads the fish to enter the white half of the aquarium. In this study, a clear difference was found between the fish coming from the enriched tank and those from the barren aquarium.

Zebra danios from the enriched aquarium were significantly less fearful and were happy to explore their new surroundings when placed into the novel test aquarium. They were

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Studies with pearl cichlids in aquariums threw up some unexpected findings.

The environment shaped the shoaling responses of cod.

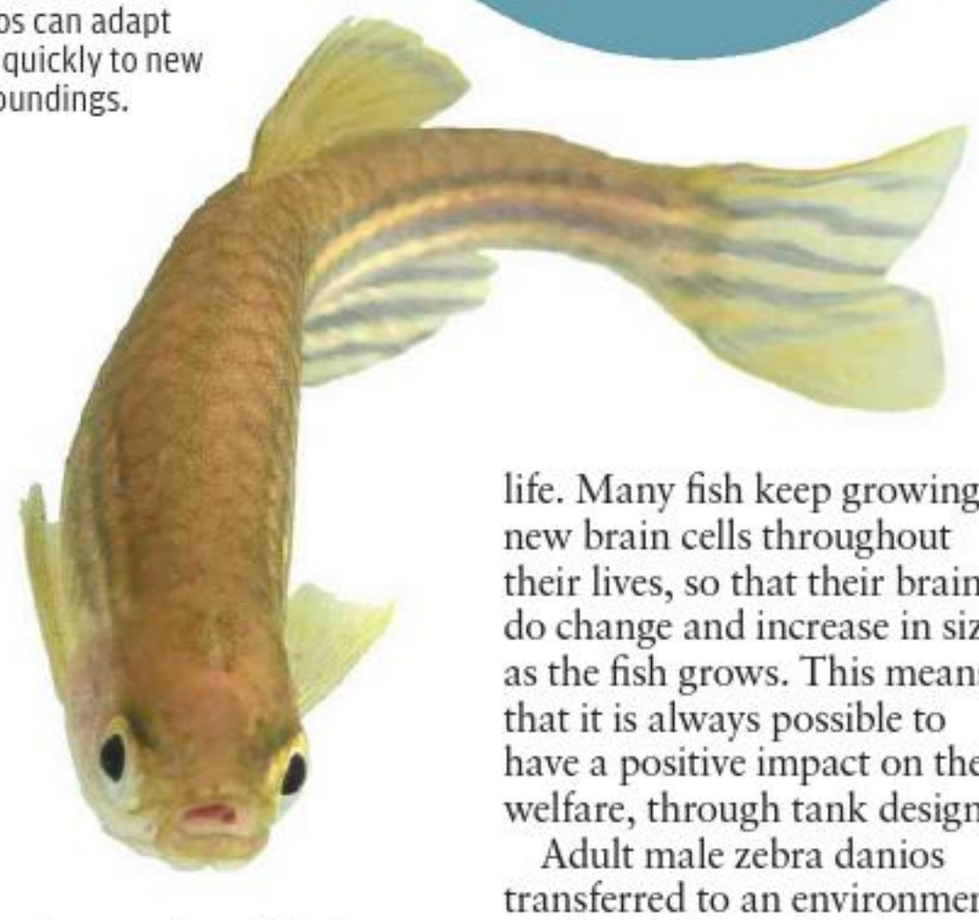
LEFT Goldfish reacted in the same way to the danios. Always ensure that rocks are adequately supported in the aquarium, sticking them together with aquarium silicone if necessary.

PARTICULAR PLANTS

Angelfish (*Pterophyllum* species) should be housed in an aquarium with tall plants with strap-like leaves. Their elongated body shape has developed to allow them to weave easily through the vegetation of this type in their natural environment.

ABOVE The substrate will provide somewhere where fish can dig and root around, just as they would in the wild, even if they dislodge some plants on occasions in the aquarium. Should it be necessary though, these can be set in pots or troughs.

BELOW Zebra danios can adapt very quickly to new surroundings.



consequently prepared to explore more in the exposed white half of the tank, compared with those that had come from barren tanks.

Reduced anxiety levels may be a sign of emotional stability and are an indicator of better husbandry and animal welfare standards. Repeating this test also showed that this result was not specific to zebra danios. Goldfish reacted in exactly the same way, showing less overall anxiety when housed in an enriched environment for two months, before being transferred across to the test tank.

Impact on feeding behaviour

Even the feeding habits of fish can be improved by environmental enrichment. Fish from barren aquariums are less able to adapt to new food items than are those reared in more natural environments. Study results have revealed that having been accustomed to a particular type of live prey, some fish kept in impoverished environments are simply not flexible enough in their mind-set to adapt to take another kind of live prey.

The extent to which enrichment can affect fish even in their physical makeup was aptly demonstrated in studies looking at the differences in the brain structure of fish raised in different environments. For example, rainbow trout fry raised in aquariums with a gravel substrate covering the floor developed substantially larger brains than those raised in similar set-ups without any substrate.

This increased size was particularly obvious in an area of the brain responsible for locomotion and the fish from the gravel-enriched aquarium had a great advantage as a result. These remarkable differences were recorded within the first three weeks of the fish's lives.

Interestingly though, there was no particular difference between fish reared in a natural environment and those reared in a very complex artificial environment. This suggests that careful aquarium design can provide very positive environments for fish early in life especially, and that a lack of such considerations can have significant detrimental effects on their well-being.

It's never too late!

However, even for fish that have grown up in barren environments, it is not necessarily too late to impact in a beneficial way on their behaviour at a later stage in life. Many fish keep growing new brain cells throughout their lives, so that their brains do change and increase in size as the fish grows. This means that it is always possible to have a positive impact on their welfare, through tank design.

Adult male zebra danios transferred to an environment enriched with artificial plants and gravel showed more pronounced brain growth than those that were kept in barren aquariums without any plants. This difference was observed in as short a time as one week. So even starting aquarium enrichment later in the fish's life is going to make a real difference to its well-being.

It is now indisputable that the environment in which fish live influences their overall welfare. Enriched underwater landscapes that resemble the species' natural habitat result in less aggressive and more socially adaptable and friendly fish. Such aquariums are also not only more interesting for the fish to live in but also for their owners to look at. It is fair to conclude that the benefits of designing an interesting aquarium layout are well-worth the effort, for all involved!

Local Retailer Guide

How my fish stopped me feeling homesick

Caring for fish can bring so many different rewards. Kevin Elsender's aquarium gave him comfort when he was miles away from home, as **Caroline Impey** discovers.

CAROLINE IMPEY
Aquarium writer

Kevin and Georgina with their 350l (77gal) aquarium.

Graduating from university is a life-changing moment for anyone. Along with a sense of achievement and euphoria, there can also be feelings of uncertainty and apprehension. Suddenly, the big wide world beckons and you're out there on your own, wanting to find work!

For Kevin Elsender, finishing his degree signified even more changes than for most graduates. As his three year course at the York St John University came to an end, so did his life in Yorkshire.

On the move

Born and brought up there, Kevin, now 24, was moving almost 325km (200ml) south with his girlfriend Georgina, to live at her parents' house in Bedfordshire.

"I was fine with us moving there," says Kevin. "We'd lived together while we were at university and Georgina wanted to be nearer to her family. She'd also got a job as a teacher. But it was actually a really big thing for me. I'd never lived that far away from home before. I was so used to the familiarity of Yorkshire!"

Not only was Kevin leaving all his friends behind, he was also moving away from the family he had been used to seeing every week. "I'm very close to my family," says Kevin. "So I knew it was going to be tough at times not seeing them that often anymore."

Thankfully, there was something that would make the whole experience easier than Kevin thought: his tropical fish.

Starting out

Kevin had been around fish for as long as he could remember. His dad was a keen fish keeper, and even as a very young child, Kevin would help to feed and care for his dad's fish.

The two of them would also enjoy trips to aquatic centres together to buy supplies or choose new fish. Then when Kevin was six, he got his first aquarium.

"I loved having my own tank," says Kevin, looking back. "It was just a 30l (6.6gal) tank with a few tropical fish. Obviously I needed help cleaning it out, but I did a lot of the care myself and I loved it.'

It was also great that he could continue to share this new hobby with his dad. Little did he know it at the time, but it was this element of fish keeping which would help him so much after he moved away from home.

Kevin as a six year old in front of his family tank.

ALL PHOTOS OF THE FAMILY'S AQUARIUM COURTESY KEVIN ELSENDER.

Setting up again

Kevin had only a small collection of tropical fish when he and Georgina arrived at her parents' house. He had kept various fish throughout his time at university and, along with all his other belongings, a few of them made the journey down to Bedfordshire.

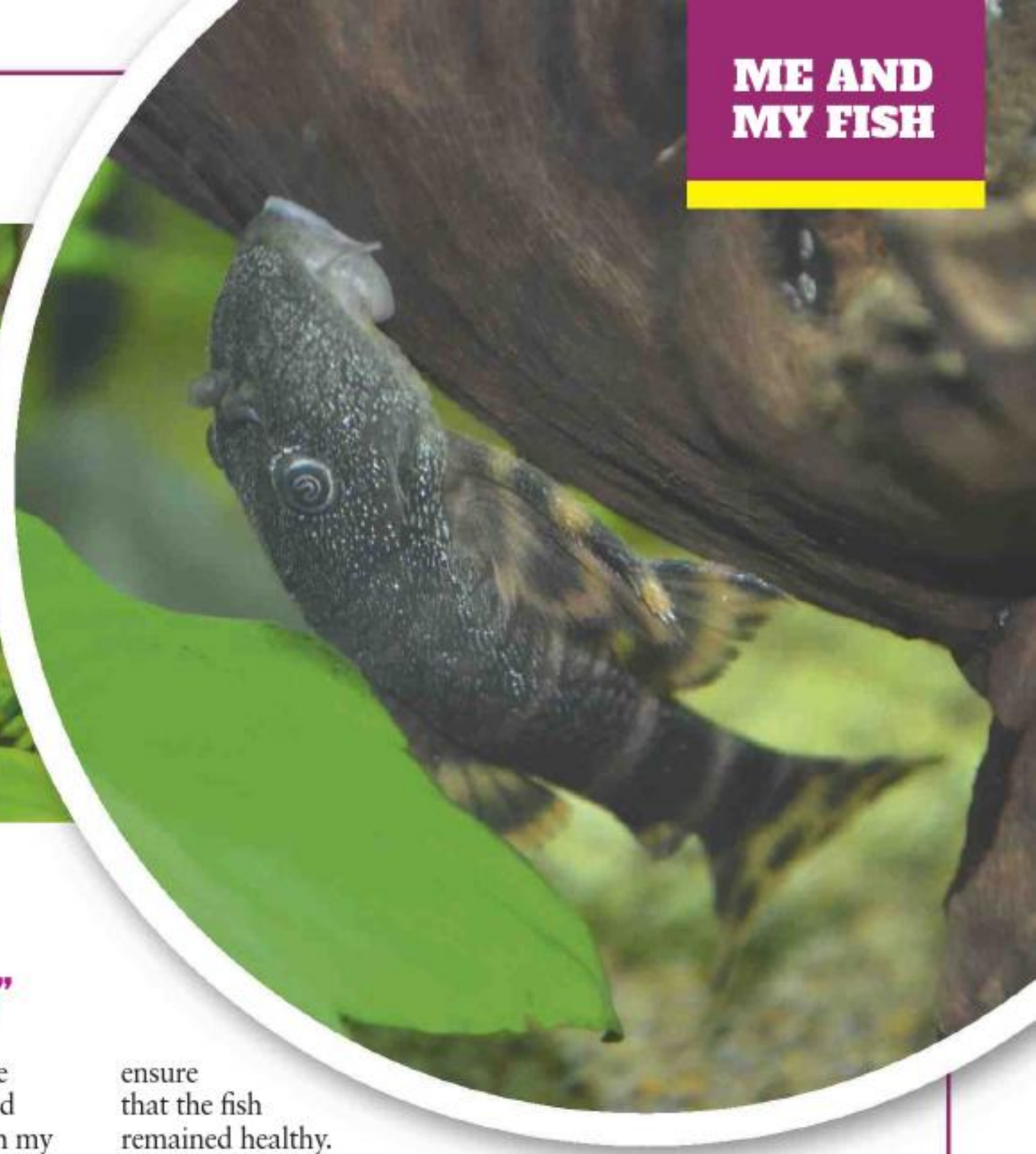
"We bought a new 60l (13.2gal) tank after we arrived and gradually added more fish," explains Kevin. "We kept it in the dining room of Georgina's parents' house and I think everybody liked having it there, and watching the fish."

Soon, Kevin was caring for a platy, a bristlenose catfish, three golden wonder panchax (a type of killifish), two koi angels and two gouramis.

Georgina started her new job as a teacher. The plan was for Kevin to get a job, and for the couple to stay with Georgina's parents while they saved for a deposit to buy a place of their own.

Difficulties arise

But, as with many things in life, things didn't go quite according to plan. "I simply couldn't find a job," says Kevin, who had gained a degree in sport and



"whenever I spent time tending to my aquarium, I somehow felt closer to home"

exercise science. "Georgina was going out to work every day and I was spending a lot of time at the house on my own while I searched online for work or applied for jobs."

After a couple of months, Kevin started to miss home. He never doubted his decision to move south, but there were times when he'd get a pang of homesickness and felt a very long way from Yorkshire.

"It was tough on occasions, looking back now," admits Kevin. "I got on really well with Georgina's family and I knew Bedfordshire was my new home. But some days, I did want to be back in Yorkshire. I just felt really far away from everything I'd been used to and all my friends and family."

How fish keeping helped

During these times, it was his daily routine with his fish that kept him going. "The thing was that I associated looking after my fish with my dad," Kevin acknowledges.

"For so many years, it had been a hobby that we had shared together and talked about. So whenever I spent time tending to my aquarium, I somehow felt closer to home. It was like it provided a link to my family. And obviously, it was a nice thing to talk about when I phoned my parents."

As well as feeling the comfort of a connection to home through his fish, Kevin also found the day-to-day care a good distraction when he had a lot of time on his hands.

His tank was planted up with live plants that required a certain amount of care, particularly to ensure that they became established. Then there were the water changes and gravel cleaning necessary to ensure that the fish remained healthy.

Kevin also benefited from the stress-relieving properties of his aquarium. "When I did get homesick, it always made me feel calmer just to watch them peacefully swimming around," says Kevin. "It was very comforting always to have them there, getting on with their day, while I got on with mine."

Things start to improve

Eight months after the move, Kevin got a job at Georgina's dad's menswear firm in Bedford, helping to develop the company's online business.

After that, things then got better and better. Having a keen interest in IT, Kevin really enjoyed the job, and he and Georgina were able to save up for a deposit for their own two-bedroom house as they had planned.

Within a few months, the couple had moved into their first home together. "It was a really exciting time," says Kevin. "It was what we had intended all along and everything was starting to come together."

A growing interest

Despite Kevin's focus on his job and setting up the new house with Georgina, he wasn't about to forget his fish! In fact, within a few months of moving, they got a new home too: a 350l (77gal) tank!

"Having our own space meant that I could really take

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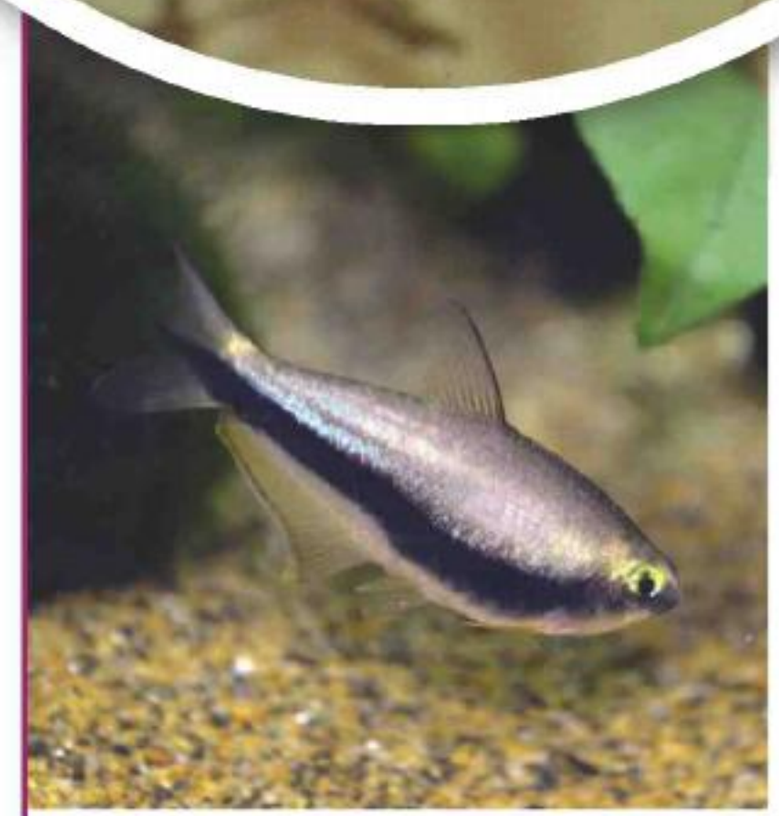
What's in Kevin's tank?



my hobby further at last," says Kevin. "I'd always known I'd have a big aquarium one day but it hadn't been possible at university or at Georgina's parents' house. The time was right and fortunately, Georgina was happy to have a bigger tank too."

Now, Kevin's aquarium takes pride of place in the couple's living room. Again, it is fully stocked with live plants and bogwood and now houses 33 tropical fish, 14 snails and two loaches.

Kevin has even expanded his hobby further, by obtaining a separate betta tank, which is home to a male dumbo betta, three neon tetras, three assassin snails and two yamato shrimp, which eat algae. He spends around three to four hours a week tending to his aquariums and he enjoys every minute of it.

"I love looking after them," says Kevin. "I don't even mind the mucky jobs that some people don't relish, like cleaning the filters. To me, that is all part of taking care of the fish."

Looking back

Kevin is a dedicated and caring owner who gives a lot to his fish. And he knows they've also given a lot to him.

"Moving away from home was a difficult time," he admits. "But I know that without my fish to look after, it would have been much more stressful. Caring for them gave me a focus and stopped me feeling homesick. I think they're fantastic pets and I couldn't imagine being without them."

What do your fish mean to you?

Why did you start keeping fish and what rewards does your hobby give you? Get in touch by emailing us at **pf.ed@kelsey.co.uk** and tell us about you and your fish...

Kevin's betta tank.

Q&A

In each issue, our team of fish-keeping experts will be answering the questions that you want answered. **Why not email us with yours to pf.ed@kelsey.co.uk?**

Butterflyfish live close to the water's surface. In common with similar fish, they have a long and relatively straight back.
PHOTO COURTESY TONIHER.

Goldfish with long fins and short, rounded bodies are not hardy enough to live outdoors permanently.

Flying fish

Q Can you give me some information about freshwater butterflyfish please?

A They can be seen as the freshwater equivalent of flying fish, being able to use the pectoral fins on the sides of their body to glide for a short distances, after jumping out of the water.

Butterflyfish (*Pantodon buchholzi*) behave in this way if they feel threatened, leaping away from potential danger. In aquarium surroundings therefore, they need to be kept in a covered aquarium where there will no risk of the fish leaping out on to the floor.

Originating from parts of West Africa, they grow to about 10cm (4in), and they can be sexed quite easily by the shape of their anal fin. This is straight in the case of a female, rather than concave as in males. When breeding is imminent, the male will pursue his mate relentlessly, with spawning generally taking place in plants. The dark-coloured eggs hatch about two days later.

Unfortunately, although it is relatively easy to persuade these fish to spawn, rearing the resulting fry is much harder. They need to be kept in a small volume of water where tiny food particles are readily available. This is because they will not chase food but simply feed on microscopic particles as they float within reach. Once this stage is passed, however, then can then be fed with less difficulty.

Butterflyfish prefer subdued lighting above their tank, and are naturally more active after dark. Floating plants on the water surface are recommended as well, providing them with good cover and helping to overcome their instinctive nervousness.

An average water temperature in the range between 24-29°C (75-84°F) will suit them well. They thrive best under soft and slightly acid water conditions, with the addition of peat to the aquarium filter being recommended for this purpose.

Butterflyfish are easy to feed on prepared foods, such as freeze-dried tubifex. Foods of this type, which float at the surface, will be required. Bear in mind also that it is not safe to house these fish in the company of smaller fish as these are liable to be eaten.

Goldfish behaviour

Q I bought my goldfish in from their pond recently, and now one of them is chasing the other around almost relentlessly. They seemed to get on without problems in the pond. What has gone wrong? Their tank is 91cm (36in) x 30cm (12in) x 30cm (12in).

A Almost certainly, this behaviour is linked to the change in their surroundings. What has happened is that the water temperature has risen again, helping to raise the appetite of the goldfish, and the lighting will have resulted in increased day length for them. This is just the same as happens in springtime – with these conditions serving to trigger spawning.

The male fish is therefore chasing the female, just as would happen then, and you are likely to find that before long, you may spot eggs scattered all around their aquarium. Should this happen when you are not around though, the chances are that the goldfish may simply eat most of them.

LEFT The moor is the only variety of goldfish which remains dark throughout the fish's life.

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Any eggs that do survive hidden on plants will need to be transferred to separate quarters. If you do not have a tank immediately available, bale some of the tank water into a plastic container, along with the eggs. These should hatch in days, and then the young fry will remain inert for the first few days, before becoming active and starting to swim in their quarters.

The young goldfish will be quite easy to rear at first on fry food and powdered pieces of flaked food, which you can break up easily by rubbing it between your fingers. As always, use a gentle sponge filter at first, and carry out regular partial water changes, monitoring water conditions closely.

Young goldfish tend to grow quite quickly, but do not be surprised that they appear to be a dull shade of green at first. This is a throwback to the colouration of their wild Chinese carp ancestor. It typically takes 6-9 months for their colour to emerge, but the period of time is surprisingly variable. They may start to change colour almost immediately, or it can take a year or more. Initially, their appearance lightens in patches, and then these areas gradually link up together.

The yellow spots are known as egg spots.

Feeding my fish

Q I'm going away for a few days, and I'm worried about what to do about feeding my fish.

A The simplest solution in this case is to provide them with a slow-release food block. You simply drop this into the aquarium and they can then nibble at it over time. Never be tempted simply to tip more food in than normal, because this will simply be wasted. As a result, it will simply start to pollute the water, and is likely to lead to a catastrophic decline in water quality, endangering the lives of the tank occupants.

A range of disasters can occur in your absence though, both for your fish and your home in general. The heaterstat could stop working properly, and although modern designs close down rather than ultimately rising to a fatal level for the fish, chilling for any length of time can obviously be fatal for tropical fish.

Try to persuade a friend or neighbour to pop in and check the aquarium for you, so that any problems can be picked up at an early stage. You may still want to stick with a food block, but if not, do stress the need not to overfeed the fish.

It can be a good idea to measure out on a piece of paper roughly how much your fish will eat at each feed, bearing in mind that some people will routinely give more generous pinches of food than others. Write down any other relevant information relating to lighting for example, or alternatively, invest in a light switch to control these automatically. This can be useful, turning off the lights should you get held up at work for example, but make sure that it will be compatible with your lighting system before buying it.

Carry out a partial water change before you go, and check all the equipment. Remember to leave your mobile number in case of any emergency, and then have a good holiday!

It is very easy to overfeed fish.

Cichlid names and care

Q Why do African cichlids have such strange names? Is eduardi an easy type to care for?

A This is a species that originates from Lake Malawi in east Africa. One of the great difficulties when it comes to describing and naming cichlids occurring there is the many localised forms living in what is more like a small sea than a typical lake.

Fish that may look superficially quite different may in fact be closely related, or they could belong to a different group entirely. As a result, their names are often in a state of flux, and many do not have a typical common name.

Lowering the stocking density will ease the burden on the filtration system.

Instead, this is often a corruption of their past or present scientific name.

You may find that some non-specialist outlets have given up trying to identity individuals accurately. Instead, they may simply have a tank of these fish and offer them as Malawi blue cichlids.

In this case, as in many, blue colouration is often the dominant colour, sometimes with blackish edging evident on the fins. They are part of the so-called 'mbuna' clan, which is a local name for members of this group, which inhabit the rocky coastal areas of the lake, where they will graze on algae and catch small invertebrates too.

Eduardi is a species that grows up to 15cm (6in) long, and it is usually, but not always possible to distinguish between the sexes, as males will have pale yellow spots on their anal fin close to the vent. This characteristic can occasionally be seen in females too. Generally though, females bite here to encourage the male to mate when they are ready to spawn.

In terms of care, these cichlids display the fairly typical requirements of others originating from this part of the world. They need to be kept in relatively hard water (between 150-200mg/l) with an alkaline pH reading of 7.5-8.0, at a temperature of around 24°C (75°F).

Eduardi will eat a variety of prepared foods, with their feeding being quite straightforward. They are also likely to nibble at plants growing in the aquarium, so only include relatively tough and preferably fast-growing plants, because otherwise, your planting scheme will soon be disrupted.

It is possible to keep a group of these fish together, but they must be provided with plenty of cover in the form of rocks and other aquarium décor. Try to design the rockwork so that it serves to partition areas of the tank, so the fish can occupy different areas of the tank, out of sight of each other. This should help to avoid conflict, but even so, you may finds outbreaks of aggression developing, particularly when spawning occurs.

This is when one of the most fascinating aspects of fish behaviour can be observed. Eduardi lay a relatively small number of eggs – up to about 30 in total. The female will scoop these up into her mouth after the male has fertilised them.

She will then keep the eggs safe in her mouth until the young fish hatch just over three weeks later and will refuse to feed during this period. Even after the young have hatched, if there is any hint of danger nearby, they can dart back to relative safety in her mouth without fear of being eaten.

Filter activity

There is a lot of muck that builds up on my filter sponges. Is this were the bacteria settle? I worry that when I rinse this off, I am reducing the bacterial population.

A Yes, the bacteria responsible for the breakdown of nitrogenous waste do become established in these sponges, but they can only function well in the presence of a good supply of oxygen, which means water coming through the filter. Once the filter starts to get clogged with debris, this restricts the volume of water that can go through the unit, and thus its efficiency, so it does need to be cleaned.

Some people make the mistake of washing the sponge under a running tap. If you do this down a sink, it is not hygienic, but furthermore, the chlorine-based compounds in tap water are likely to reduce the number of bacteria.

It is very simple to avoid this difficulty though, if you service the filter as part of your routine maintenance just after carrying out a partial water change. All that you need to do, wearing a pair of rubber gloves, is simply to squeeze the foam repeatedly in the bucket of water that you have siphoned out of the tank. This will serve to remove most of the debris that has accumulated here, potentially blocking the pores in the sponge.

However, the big advantage of cleaning the sponge like this is that there is no danger that you could destroy the bacteria, as they are not exposed to chlorine in any form. Alternatively of course, you could wash the sponge in a bucket of dechlorinated water.

Try to avoid replacing the sponge if possible because, yes, it will take time for

ABOVE A filter sponge supports a high density of beneficial bacteria.

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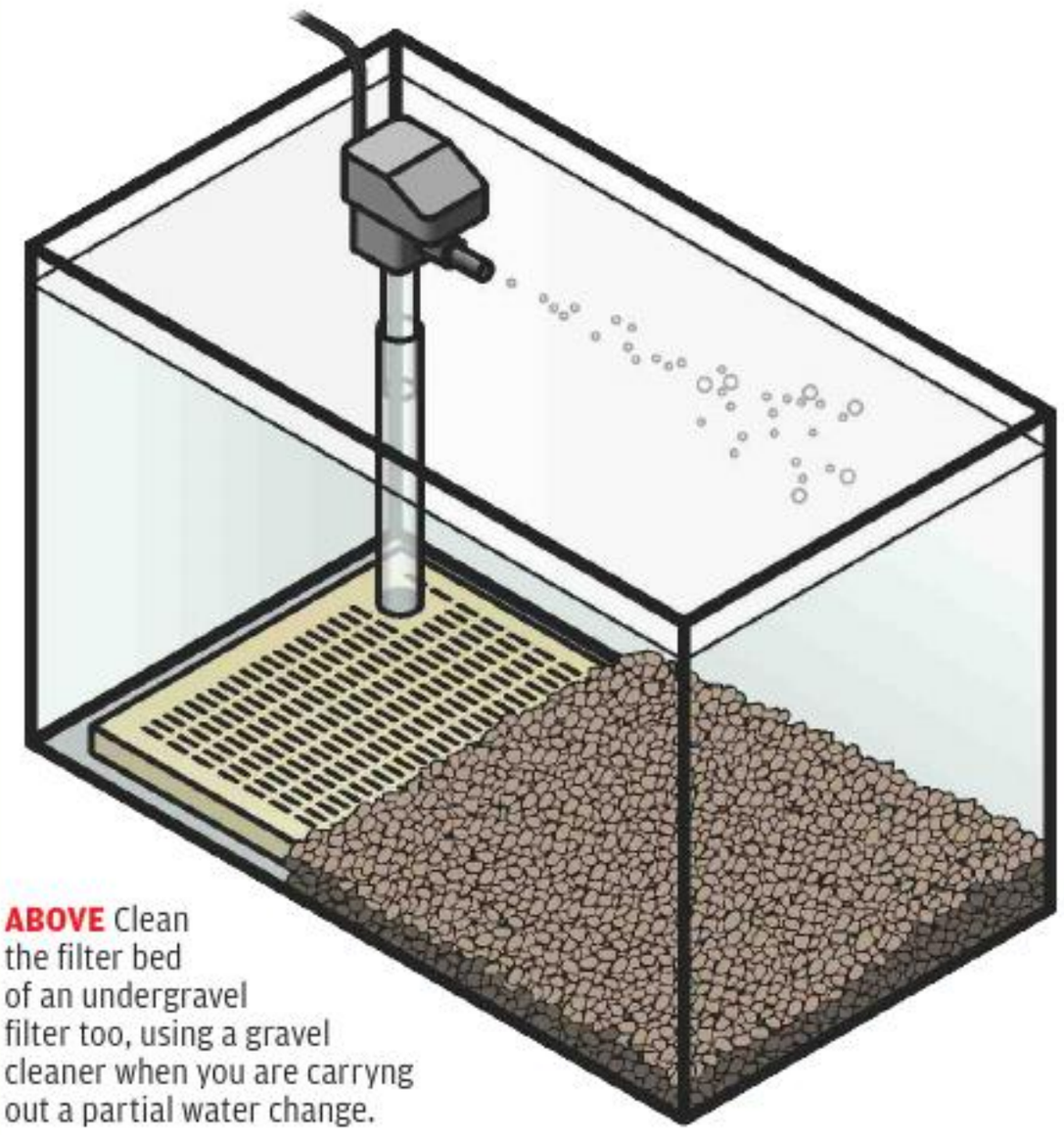


ABOVE Clean the filter bed of an undergravel filter too, using a gravel cleaner when you are carryng out a partial water change.

bacteria to recolonise the area here. It will not be like starting afresh with a new tank, because there will be bacteria established in an undergravel filter if you have one, but it is important to monitor water quality afterwards, for any signs of deterioration, such as a rise in nitrite for example.

In order to minimise the risk of problems, add a beneficial bacterial culture to the tank, as this should seed the new sponge more rapidly. Should you have an undergravel filter, use a gravel cleaner, to remove debris here, ensuring that this system will be working at maximum efficiency. If not, you might even want to consider reducing the stocking density in the tank for a time, transferring some of the occupants elsewhere, so as to reduce the load on the filter.

Snail problems

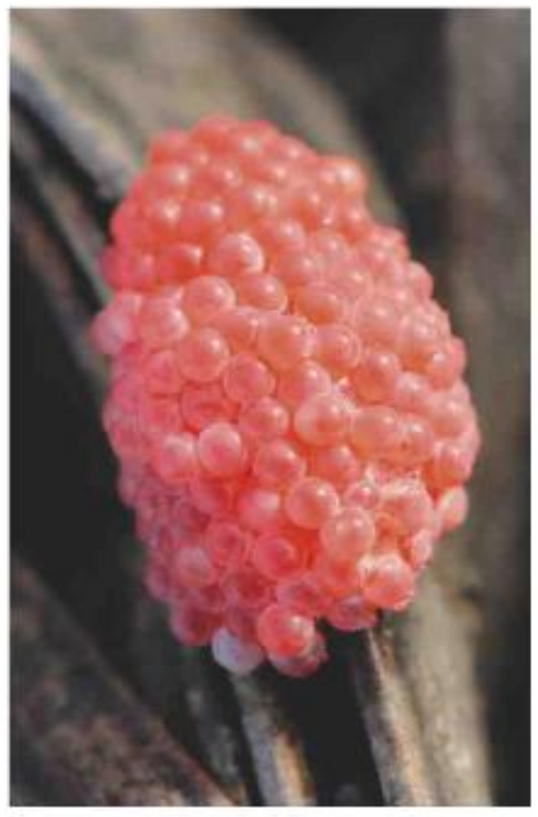
I had this dream of a beautiful planted tank, with everything living in harmony. Unfortunately, it hasn't quite worked out like that, as the snails are destroying the vegetation, and they seem to be everywhere. What can I do?

A You don't say what your tank conditions are, but it might be possible to introduce a freshwater pufferfish that will feed on the snails, and so reduce their numbers. A more general solution may be to purchase a snail trap, but you need to be careful that this will not end up trapping any of the fish.

Perhaps the simplest and cheapest solution though is simply to use a small, clean saucer and prop this up securely on small stones at the base of the tank. These need to be high enough to allow the snails to crawl underneath.

In order to attract them here, place a slice of organic cucumber under the saucer at dusk. By morning, you should find a good cluster of snails attached to the underside of the saucer, having eaten the cucumber. It is then simply a matter of taking out the saucer, and disposing of the snails.

Never, ever be tempted to release them into a pond or any similar stretch of water, as this is not only illegal, but could cause serious environmental damage. Should the snails become established in the wild, then this will simply magnify the problems that you encountered. This is why the European Union banned the attractive apple snail from sale, after



A mass of apple snail eggs.

populations of this South American species were found in the Ebro River delta, in eastern Spain.

Even within the aquarium, you will need to remain vigilant, because snails breed so fast. This is because they are hermaphrodite, which means that the reproductive organs of both sexes are present in a snail's body, so keeping two together will inevitably result in fertile offspring.

BELOW A yellow apple snail (*Pomacea bridgesi*) now banned from sale, for fear that it could become an invasive species.

Signs of snail damage can be seen here.

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Fish Doctor

Tackling the health problems that you want answered. **Why not email us with yours to pf.ed@kelsey.co.uk?**

Q Having just set up an aquarium, how will I be able to tell from their behaviour if any of my fish are ill? I haven't been able to find out much about this topic.

A Simply watching the fish as they swim around in the aquarium is very important, when it comes to recognising signs of illness. Take time to observe your fish closely every day, particularly when you are feeding them.

Firstly, the most obvious question – are they all eating well? It can be difficult to be sure in some cases, especially with catfish that are nocturnal in their feeding habits. You can overcome this difficulty to some extent by feeding these fish at night, with the aquarium lights turned off and the room lights low. This will allow you to check that they are eating normally.

Aquarium fish generally feed a little and often, and so the introduction of food into the tank should soon see them circling around in search of tasty morsels. It is not just a question of seeing them eat, however, but also watching how they feed, as this could alert you to potential problems.

Note any individuals that eat, and then spit out their food immediately afterwards. If this happens occasionally, particularly if the fish is being chased by a companion, this need not be a cause for concern, but if it happens regularly, then it can be an early sign of so-called 'mouth fungus', which, in spite of its name, is actually the result of a bacterial infection.

It is caused by the bacterium *Flavobacterium columnare*, and this helps to explain the alternative common name of this illness, which is columnaris. Treatment therefore relies on anti-bacterial agents, rather than those used to counter fungal disease.

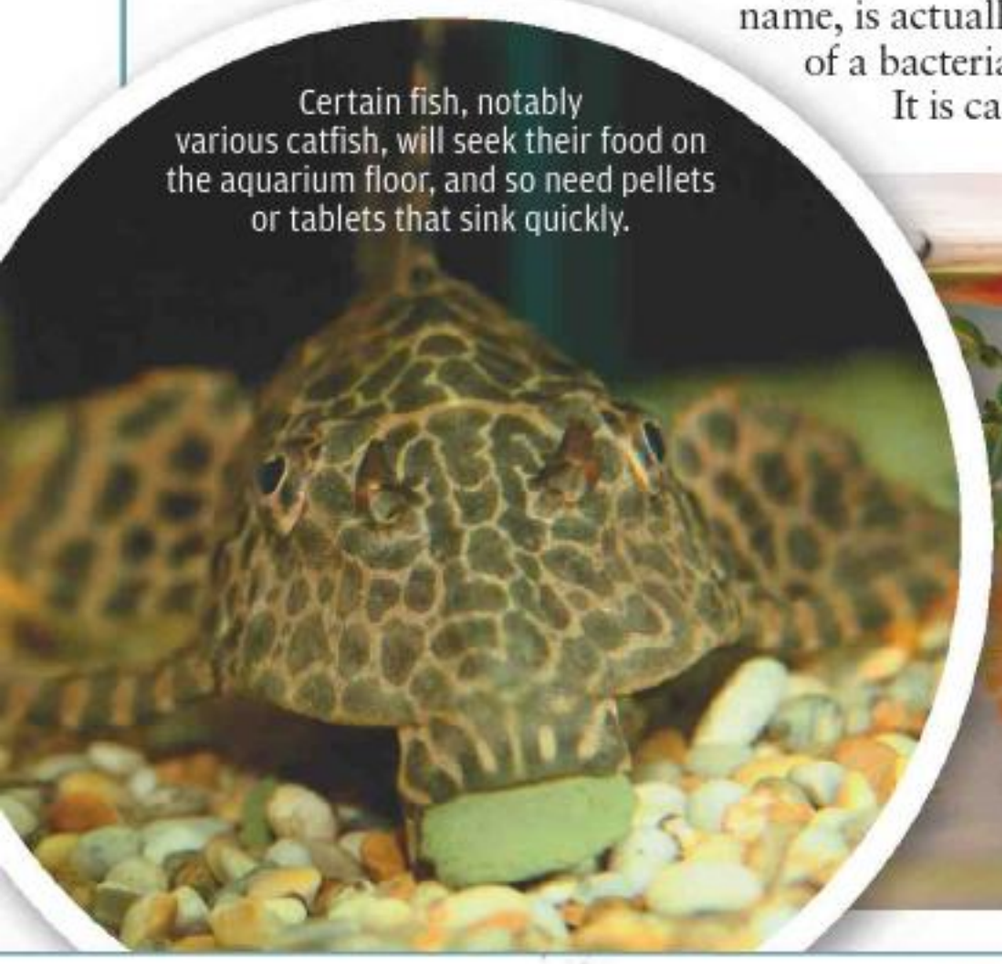
Many cases of illness in fish can be linked with poor water quality, either prior to or after purchase. The stress of the move and the change in environmental conditions puts the fish's immune system under greater challenge at this stage, and therefore increases the likelihood of illness developing.

There can be various reasons as to why fish may not eat, including environmental ones, such as too low a water temperature. Check that you are offering suitable food for the species that you are keeping as well. It is better to err on the side of caution and offer smaller particles of food. Beware of bullying as well, because this can lead more nervous individuals or species to hide away when

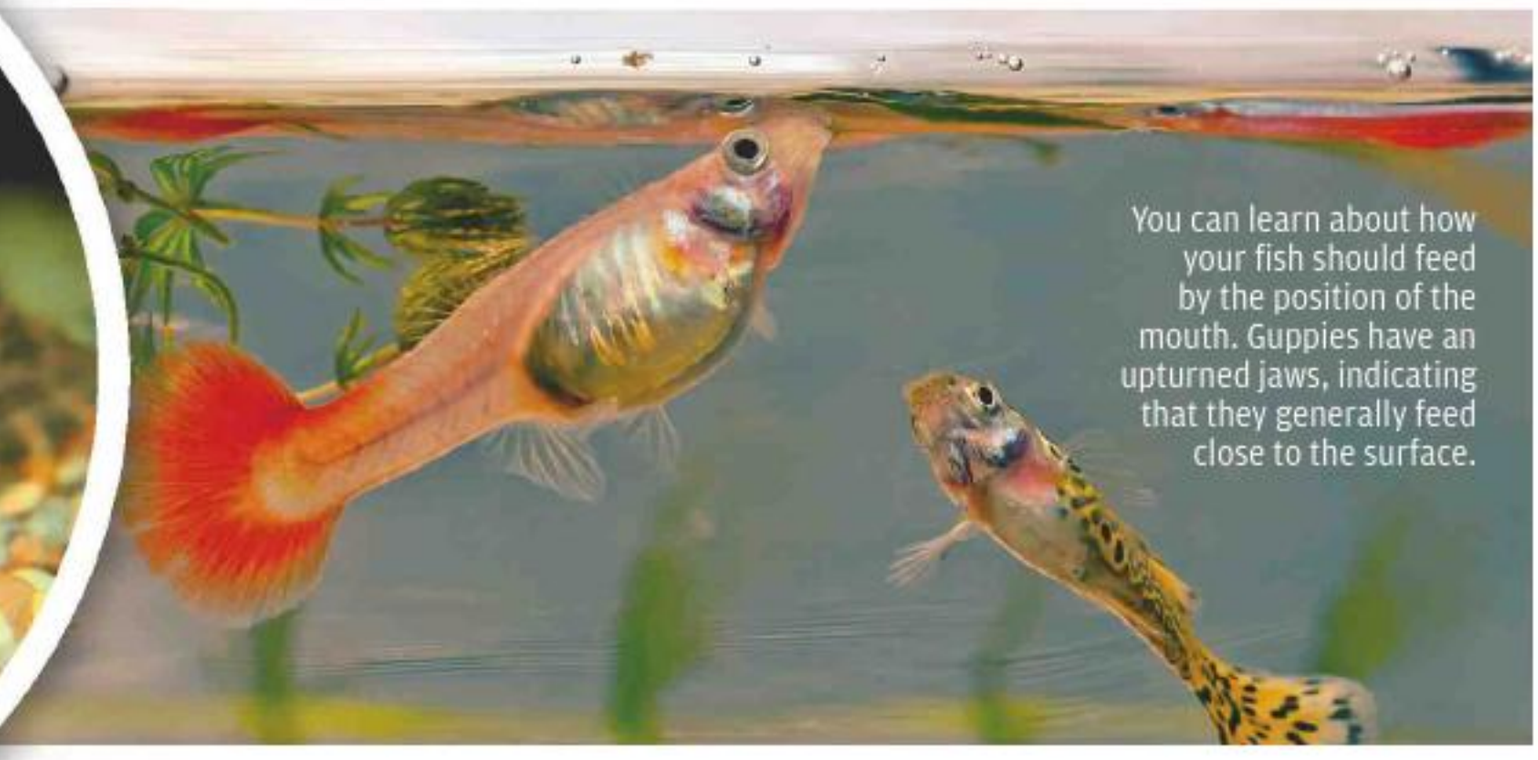
ABOVE Flake food floats at the surface, making it relatively easy to watch many of the aquarium occupants feed.

Top Tip

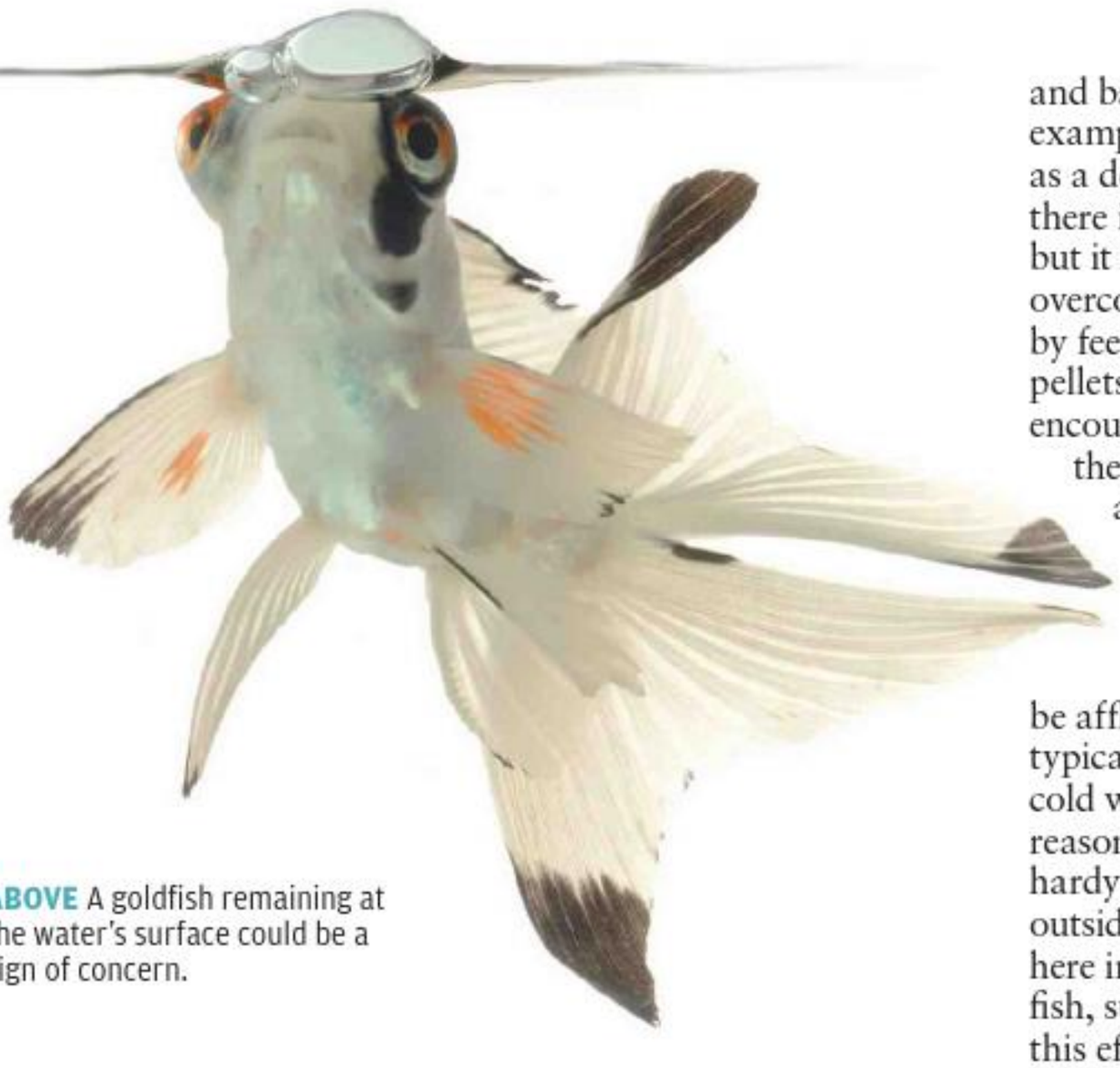
Always think in terms of cause and effect as far as fish health is concerned. As an example, poor water quality is likely to have the effect of triggering physical signs of illness amongst fish in the aquarium. It is therefore not just a question of treating the illness, but finding and addressing the underlying cause.



Certain fish, notably various catfish, will seek their food on the aquarium floor, and so need pellets or tablets that sink quickly.



You can learn about how your fish should feed by the position of the mouth. Guppies have an upturned jaws, indicating that they generally feed close to the surface.



ABOVE A goldfish remaining at the water's surface could be a sign of concern.

food is being offered.

Introducing more décor such as rockwork and bogwood as appropriate can help to divide up the tank, providing more cover in these circumstances and thus serving to reduce territorial aggression. Otherwise, if the situation is allowed to persist, then the fish will become weakened over a period of time, and they are likely to start succumbing to opportunistic fungal infections.

Q Can I tell anything from the way that the fish swim? Do they stop swimming when they are ill?

A This is really only likely to happen in the terminal stages of an illness, with the fish then simply floating at the water's surface. Yet there are useful clues that you can pick up by watching as they swim around the aquarium.

Fish that spend their time hanging at the water surface will indicate that there could be water quality issues in the aquarium. This type of behaviour needs to be investigated. Some fish such as hatchetfish will of course congregate in the upper part of the tank close to the surface, and this is not a cause of concern. By watching your fish, you will soon recognise their normal patterns of behaviour, and so will be able to spot when something is wrong.

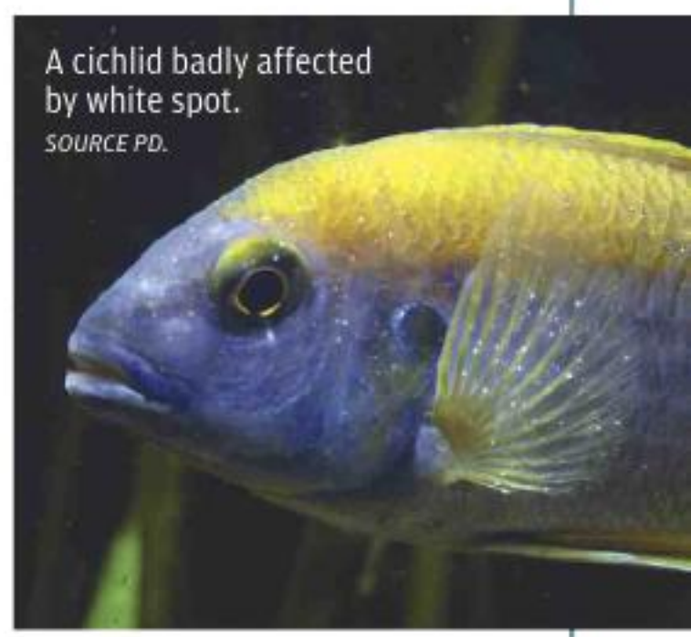
If the swim bladder, an air-filled structure in the body that regulates buoyancy, is affected then the fish will have difficulty in swimming normally. It may not be able to dive effectively, and often ends up with its body tilted at an abnormal angle, bobbing in the water. Alternatively, such fish may sometimes end up on the bottom, simply resting here after struggling to swim.

Swim bladder problems can be a particular problem in the more corpulent strains of fancy goldfish and balloon mollies for example. Unfortunately, as a developmental issue, there is unlikely to be a cure, but it may be possible to overcome the worst symptoms by feeding the fish with pellets that sink, rather than encouraging them to feed at the surface, where they are likely to gulp down air along with their food and worsen their state of health.

Fancy goldfish can be afflicted like this in ponds, typically during a spell of cold weather, which is one reason as to why they are not hardy enough to overwinter outside in a typical winter here in the UK. With tropical fish, sudden chilling can have this effect as well. If you notice that your fish are less active than they have been, and some are resting at an unusual angle in the water, then check the temperature in the aquarium as a first step.

If only one fish is affected in this way, however, this can often be just a sign of old age, especially in the case of livebearers such guppies, which only have a relatively short lifespan and may already be quite elderly in relative terms when you acquire them.

ABOVE A dramatically shortened body can predispose to swim bladder problems.



A cichlid badly affected by white spot.
SOURCE PD.

Q Are there other clues from the way that a fish swims to indicate that it could be ill?

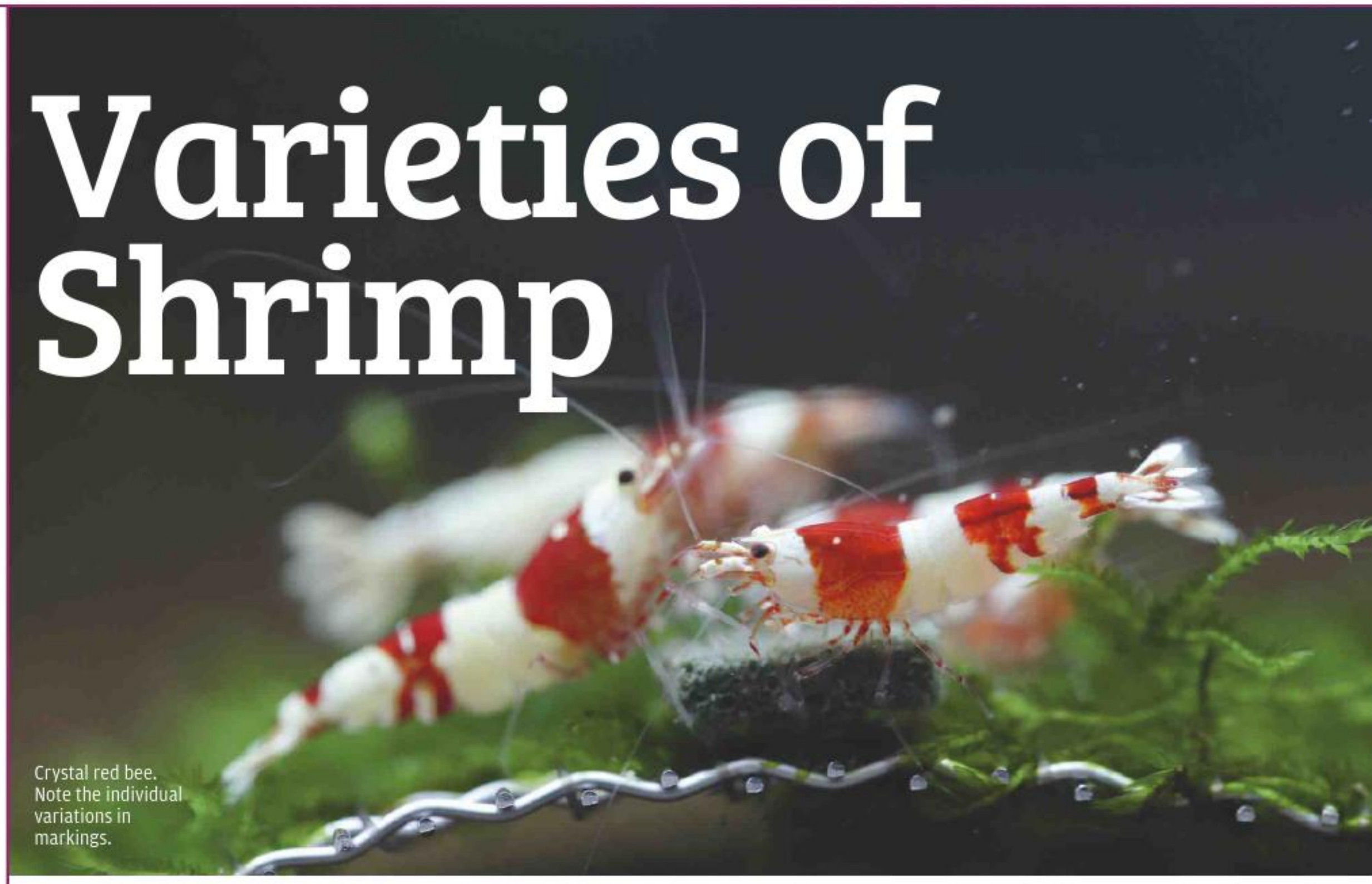
A A fish that rubs repeatedly against rocks and other décor in the aquarium is likely to be afflicted by an irritation over the surface of its body. External parasites may be responsible.

Small white spots evident here are indicative of the parasite called *Ichthyophthirus* – better known simply as ick, while in other similar cases, excessive production of mucus may be apparent, triggered by the irritation and affecting the fish's colouration, so that its appearance is duller than usual.

Parasitic infections of this type will spread easily through the water. You must therefore isolate an affected individual immediately, and keep a close watch for any others developing similar symptoms.

Be careful when using any medication in the main aquarium because if you have carbon in the filter, this is likely to inactivate the treatment. In addition, certain dye-based treatments will not only colour the water, but they are also likely to stain the silicone sealant that holds together the panels in the case of a glass aquarium.

Varieties of Shrimp



Crystal red bee. Note the individual variations in markings.

Shrimp-keeping is growing rapidly in popularity, fuelled in part by the trend for smaller tanks, and particularly desktop setups. Here in the fourth part of his series, **Lucas Witte-Vermeulen** of Sharnbrook Shrimp describes some of the different types of shrimp that are available, and provides a guide to their specific needs.

The main focus of my article is this issue is going to be the species known scientifically as *Caridina cantonensis*. It occurs in the form of a number of different variants, being most commonly represented in the hobby today by the crystal red bee shrimp.

The original form of this shrimp is present in southern Asia. It is an unremarkable brown and pale orange/white striped crustacean that is to be found in pristine mountain streams. But then in 1996, a few wild bee shrimp with red colouration were found living in streams in Hong Kong, by Hisayasu Suzuki. These shrimp were the foundation for one of the most popular variations of this instantly recognisable and stunning form, which is now called the crystal red bee.

The Caridina crystal red bee shrimp that you will find for sale in the UK are all captive-bred and bear little resemblance to their distant relatives, which still thrive in closely-guarded secret streams in Hong Kong and elsewhere in southern Asia.

Crystal red bees rank amongst the most popular varieties.

ALL PHOTOS BY LUCAS WITTE-VERMEULEN OF SHARNBROOK SHRIMP.

Further developments

Subsequently, other variations were discovered amongst the shrimp populations being kept in breeders' tanks. These were then carefully line bred, being paired to maintain and hopefully increase the distribution of the genes responsible for their changes in appearance. Ultimately, such populations of shrimp then started to breed true, producing offspring that resembled themselves.

Certain breeders would focus on developing the patterning, while others looked to concentrate on improving colour intensity. A number aimed to achieve both, resulting in the stunningly beautiful pure red form. A typical average shrimp of this type, as illustrated here, will cost about £50 ($80) in the UK.

On the other hand, it is not unknown for individual highly prized specimens to fetch upwards of £6000 ($10,000) in auctions across Asia, where

Snow white shrimp.

they are highly sought-after. Whilst prices of shrimp have come down substantially, perfect specimens and rare breeds can still change hands for massive sums of money, partly because of their breeding potential.

Pale appearance

The snow white is another variety of crystal shrimp that is often seen these days. It has been bred from crystal black shrimp lacking this dark pigment. The golden is similar, but originates from the crystal red shrimp, and has a slightly golden hue, as its name suggests.

Sometimes these varieties are bred back with crystal red or black shrimp to produce individuals with more white. However, as such shrimp are then no longer considered to be pure breeds, so the demand for them is less, and they do not fetch very high prices.

Tigers

Some fantastic mutations in colour occurred in breeding colonies of red and black crystal shrimp. These were named Taiwan bee shrimp as a result of where they first occurred. There are many different rumours of how they came about, but that is another story!

Tiger shrimp, which are a distinctive form of *Caridina cantonensis* found in the same region, have also been crossed with regular crystal shrimp and this has produced some interesting results. The offspring of a tiger shrimp mated with a crystal red shrimp results in what is known as a tibee shrimp.

Crystal bee black shrimp.

Crossing between a tiger shrimp and a Taiwan bee shrimp has resulted in the creation of what is now known as a fancy tibee shrimp. Nevertheless, tiger shrimp are very interesting in their own right, and have also been bred to create some incredible colours like the royal blue tiger.

Some black Taiwan bee shrimp with names like King Kong and panda occurred, displaying tints of blue, and you may well guess where this led! Yes, these shrimp were bred to create more colourful choices like the blue panda and blue bolt. Now there are even green hulks and a myriad of new variations, including

CONTINUES ON THE NEXT PAGE »

DID YOU KNOW?

If you cross a crystal red shrimp with a crystal black shrimp, then you will end up with the majority of the young resembling crystal black shrimp. This is because the black ones carry a dominant gene, with the red form being recessive.

Tibee.


Red Taiwan bee.


Tibee.


Blue bolt.


Royal tiger blue.

the expensive pinto shrimp.

In a future article in this series, I will explain the genetics of these shrimp in more detail, and how to create your own variations, which is one of the fascinating and addictive aspects of the hobby for those interested in breeding shrimp.

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Care

Most of these shrimp used to be considered hard to keep; however, probably as a result of tank breeding over many generations now, they are not as sensitive as they were once. This could be a reflection of a broadening of their gene pool, and/or many colonies might be becoming more adapted to different water parameters and have better resistance to previously unfamiliar bacteria and other disease-causing microbes.

All shrimp need mature tanks, clean water and a low (acidic) pH though. The following are the water parameters that I use for my shrimp. However, it is stability in terms of water conditions that is the most important factor in their care, and so this list needs to be considered primarily as a guide, rather than as an absolute instruction manual.

Total dissolved solids (TDS) 150-200 (using reverse osmosis (R.O.) water that is re-mineralised with Mosura Mineral Plus Ultra).

pH: 6.0-6.8.
Temperature: 18-22°C (64-72°F).
Substrate: Ebi-Gold Shrimp Soil. This keeps the pH low and stable.
Plants: Lots of Java moss and Java fern.
Lighting: TMC Aquabars or GroBeam 600ND or MiniLed 400.
Filter: Air-fed sponge filter; nothing high-tech is needed!
Food: Mosura Specialty CRS Food, Excel Food, Bioplus, Tonic Pro, Graze and Indian almond leaf or bark (also known as catappa).
Beneficial bacteria: Mosura BT-9 (and DeNitro if you have relatively high nitrates).
Additives: Mosura Old Sea Mud, Richwater.
Decoration: Shrimp tubes for shrimp to hide.


Blue panda Taiwan bee.

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Understanding aquarium lighting technology & LEDs

Puzzled by the different types of aquarium lighting and what would be most suitable for your set up? Let lighting expert **John Courteney-Smith** advise you.

The provision of aquatic lighting products has changed beyond all recognition over the last five years. When I first started at Arcadia, all we really had to offer was standard output T8 fluorescent lamps and metal halide systems for use in conjunction with marine and large freshwater aquariums.

Shortly afterwards, High Output T5s entered the market. These represented a significant advance, by increasing the amount of visible light available per watt of energy used and as such, they served to raise what is often described as the 'photosynthetically active radiation' output - abbreviated to PAR - and lowered the overall running costs of the lighting system.

Metal halide lamps are actually quite efficient at providing a higher level of light and also distributing PAR energy from light over a wide area. Getting the PAR right is essential for aquariums incorporating live plants, and in marine tanks, where there are algae present in association with corals.

A T5 fluorescent represented a major advance in aquarium lighting technology. *PHOTO COURTESY OF ARCADIA.*

Air versus light

Living plants depend on the energy from specific wavelengths of light, in order to be able to photosynthesise and thus grow. Simply placing a light over an aquarium will not guarantee that your plants will thrive – it needs to be of the right type.

Water itself has what is known as a V value or refractive index. Every transparent item has its own refractive index and it is this index that dictates just how light passes through the medium concerned. Air is denoted by an index

Healthy marine tanks need lighting that mimics the effect of sunlight, as do freshwater set-ups, but the way that light travels through saltwater is slightly different. *PHOTO COURTESY OF ARCADIA.*

of just 1.00. This means that light travels through air very well indeed, and is not changed very much in terms of concentration or colour aberration, meaning that its brightness and colour are not affected.

In contrast, the refractive index of water is around 1.33 and as such, the light itself entering here will be concentrated into a smaller area and it becomes more subject to both colour aberration and colour change. In this type of situation, many PAR readings that are taken are inaccurate. A reading from a PAR meter taken through air will always be higher than if the same lamp is directed through water.

When checking on the stated PAR level for your aquarium therefore, you should be clear that the figure advertised has indeed been taken through water and not through the air. It is also worth pointing out that if salt is added to an aquarium, even to create a brackish rather than a marine set-up, the refractive index increases marginally, and this will still be sufficient to impact on the light and its passage through the water.

In terms of cold water or tropical aquariums where live plants are not included, or if low light species of plants are chosen, then the PAR output of a lighting product does not matter too much. Fish are not reliant upon solar energy in the same way as reptiles and birds, and therefore a lower power light fitting can be safely used, without any risk of harm to their health. This light source, however, should be of a sufficient quality to show the fish themselves off in the very best light, so to speak!

LEFT Plants will only photosynthesise and thus grow when exposed to the correct wavelengths of light. *PHOTO COURTESY OF ARCADIA.*

Concentration on colouration

Historically, a huge amount of work went into creating aquatic fluorescent lamps that served to highlight the natural colouration of the fish themselves. This is one limitation that applies to light-emitting diodes, or LED lights as they are now generally better known. The number of colours that need to be mixed together to re-create this type of colour rendition is very difficult indeed.

The original tropical lamp for instance has peaks in the red and blue areas, but also includes some greens and yellows in the mix as well, to provide a balance. There are also expensive phosphors that pick out colours on fish and plants that are simply not available to the human eye with standard lighting.

It has to be said that in this context too, using a typical warm or cool white household-type lamp above the aquarium will do nothing to show off the colours of your fish. Furthermore, it can cause problems too, by promoting the growth of unwanted algae, which may spread on to the sides of the tank, as well as coating rockwork and other tank décor.

ABOVE Special aquarium lighting is needed to capture the beauty of fish, as with this discus, and to aid the growth of plants.

Why PAR matters

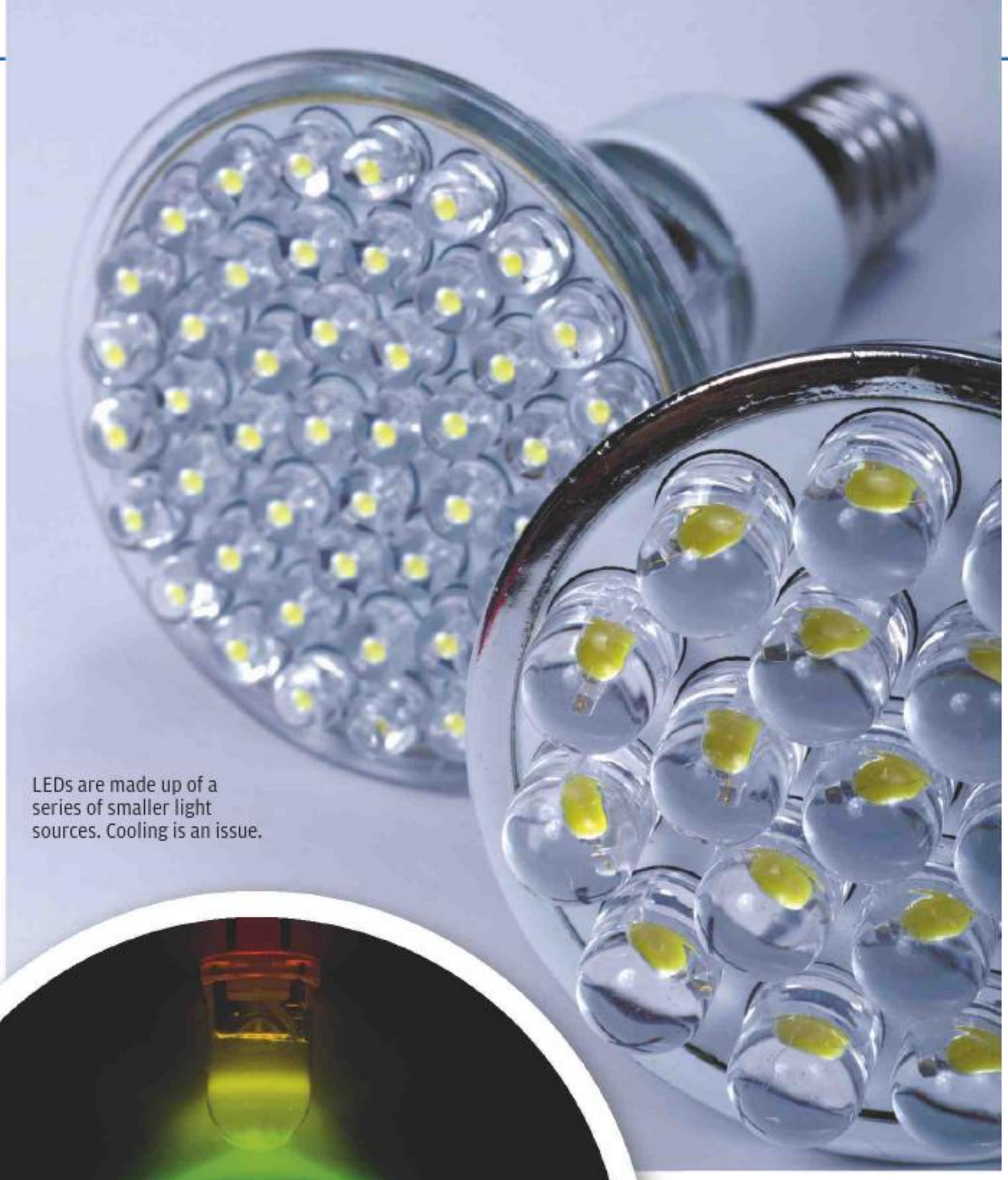
Aquariums incorporating live plants, and marine set-ups with live corals will require a higher PAR to encourage the proper and sustained growth of these plants and those feeding of corals. It is imperative to choose a system that not only provides light at the right wavelengths to allow for good growth but one that provides the right PAR for the species that you aim to keep in the aquarium where

CONTINUES ON THE NEXT PAGE »

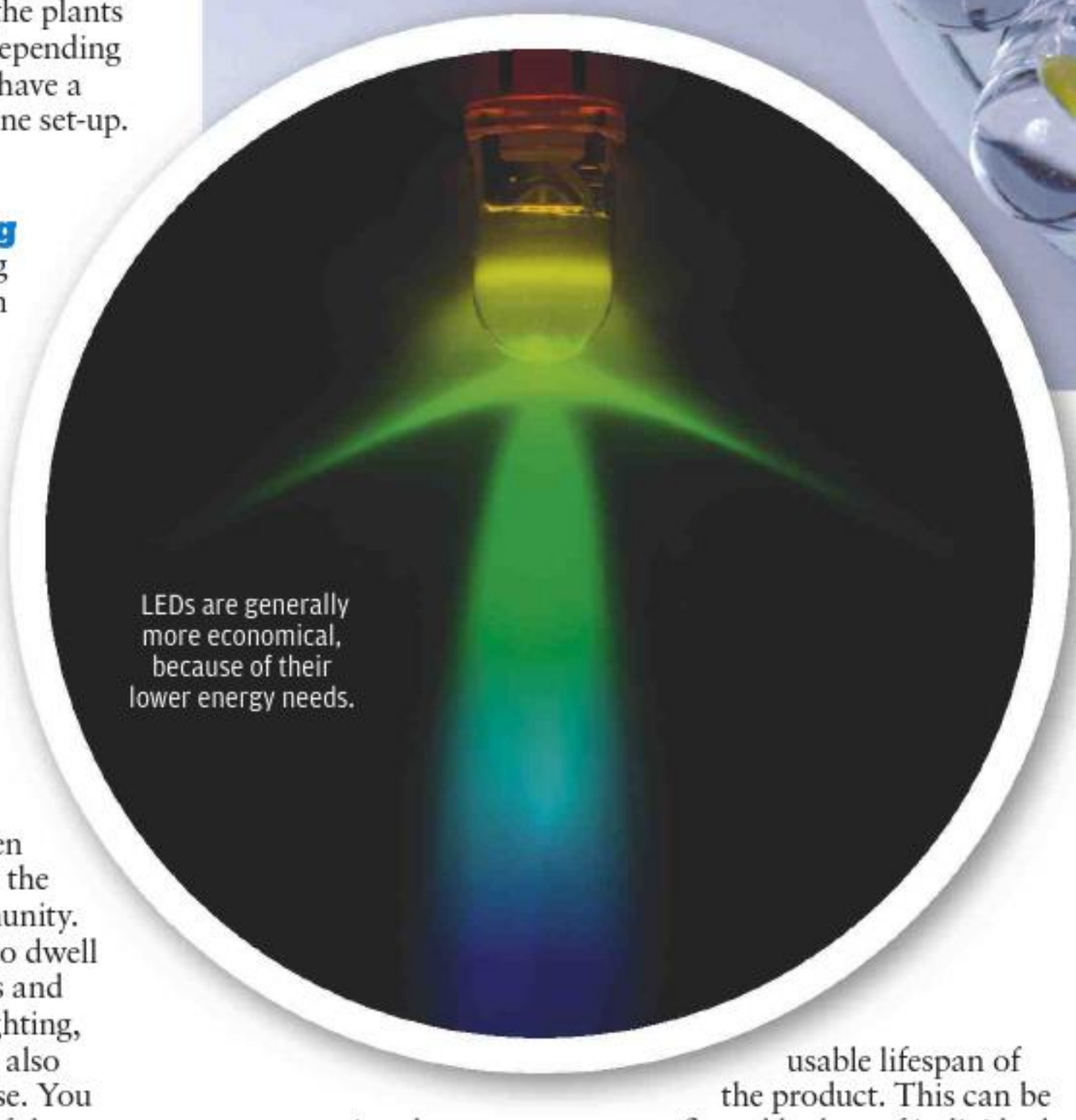
the lighting is to be used.

PAR levels, in common with the light itself, decrease in strength the further that the light has to travel from the light source. As a result, the light source needed for plants situated at the bottom of a tank that is, for example, 76cm (30in) deep will need more power than would be required for the same plants in an aquarium that is just 46cm (18in) deep.

In order to be sure that you are providing the right amount of light energy to the plant concerned, based on its position, study the product information that comes with the light. You will then be able to ascertain whether the lighting system will be able to project the PAR to the level that is required, within the tank, in order to meet the needs of the plants or indeed corals, depending as to whether you have a freshwater or marine set-up.



LEDs are made up of a series of smaller light sources. Cooling is an issue.



LEDs are generally more economical, because of their lower energy needs.

LEDs - a new type of lighting

The area attracting a lot of attention in aquarium lighting today – as it is in other fields of electronics, notably televisions – is of course the use of LEDs, which stands for light emitting diodes. LED lighting is now being used in a wide range of areas, and this technology has been readily adopted by the fish keeping community.

While it is easy to dwell on the applications and benefits of LED lighting, there are of course also limitations to its use. You need to be aware of these shortcomings, so you can make fully informed choices about what is right choice for you and your own set-up(s). In this way, you can then obtain the best lighting solution for your fish.

Firstly, always remember that LED is, by definition, a point source. This means that the light that is produced is very directional and only covers a pointed or narrow area. In many cases, LED products for aquariums will use an array of LEDs placed quite close together to obtain a "flood" of light, rather than a potential series of pin spots through the water.

This does of course work quite well, but on the other hand, LEDs need to be kept cool, and placing cells closely together may decrease the usable lifespan of the product. This can be reflected by loss of individual cells, or even the failure of the whole product, which then needs to be replaced, making it a relatively costly option should this happen.

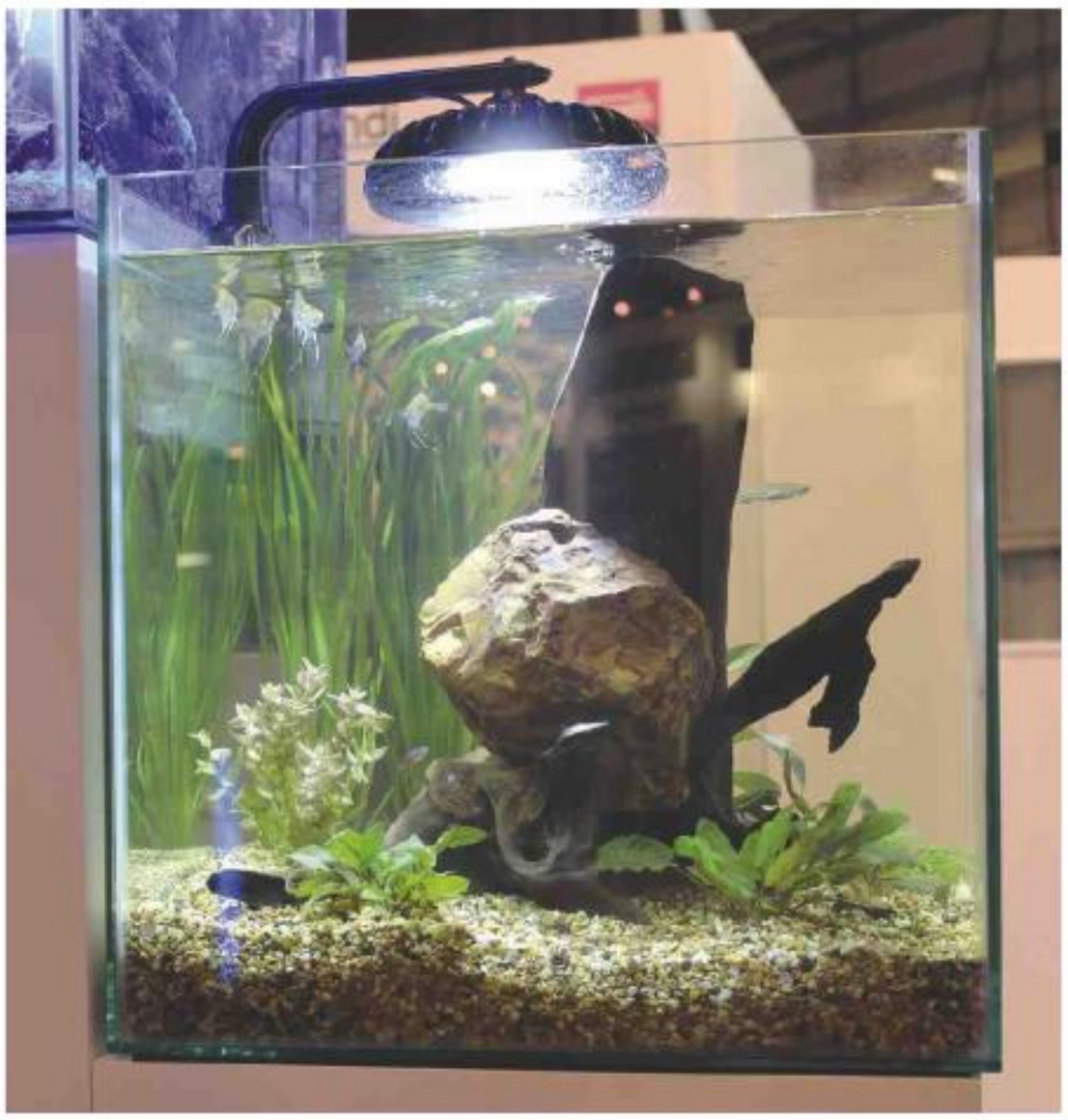
Adjusting focus

A different way to spread the light from a point source is to use a prism. In much the same way as you will remember from school, a prism increases the angle of projection and the area over which the light falls. This can then in turn cause some colour aberration issues because of the prismatic effect.

Higher quality LED units therefore use a lens or prism to a degree where the LED cells can be placed safely away from each other, but the light emission will still overlap per cell and so creates the overall impression of creating a flood rather than a point source of light.

These lenses can be built into the unit or in some fittings, they can be removed and as such, it is then possible to interchange the lens to suit the needs of the aquarium. In the Arcadia 30W LED spot for example, there is an interchangeable option to alter the lenses between 40, 80, and 120 degrees. These lenses of course change the potency or direction of light as it enters the water.

The tighter the beam, as in the case of the 40°, so the thinner the column of light,



LEFT Safety is a key issue with aquarium lighting systems – don't take chances with inferior products.

and the more concentrated the beam becomes in terms of PAR. This allows you to concentrate on a particular planted area of the aquarium, helping you to grow plants there, whereas the fish may benefit from having an area that is less well-lit.

It is fair to say that LEDs can revolutionise your aquarium and its management, by offering a point source of light. Furthermore, if you have good water movement, you will see an attractive rippling effect in your aquarium using LED lighting (if set up correctly). You simply will not be able to recreate this with fluorescent lighting. Even so, it needs to be said that while this is certainly attractive, it will bring no beneficial health effects to your system as such.

Energy and lifespan

LEDs generally use less energy to light an aquarium, which makes them cheaper to operate in general terms. However, in order to obtain the correct PAR in some cases over the area of your tank, you may need a lot of cells.

If this does apply in your case, then this will serve to increase your initial spend on the lighting system, and of course, it will also increase your on-going energy consumption. I have seen systems that have been wonderfully illuminated with LED that use more power than a halide would, to light the same area. This is not a very common situation, but it is possible and should be considered.

LEDs can have quite a long lifespan and are commonly advertised as lasting for 50,000 hours. This, of course, saves you having to replace lamps every 6-12 months, but it is entirely dependent on the quality of LED used and the heat that builds up around it. LEDs fitted in hot environments and that have not been attached to good enough heat sinks are almost certain to have a much shorter lifespan than those that are better designed and used in cooler surroundings.

Control and safety

Another advantage of LEDs is that they are also controllable. These controllers are a very useful tool for all systems. They are usually able to re-create periods of dusk and dawn, and some even have a moonlighting setting. This stops your fish waking suddenly with a start when the lights are switched on, or being plunged into total darkness in the blink of an eye. Again though, these controllers need to be kept quite cool and dry or they can be prone to failure.

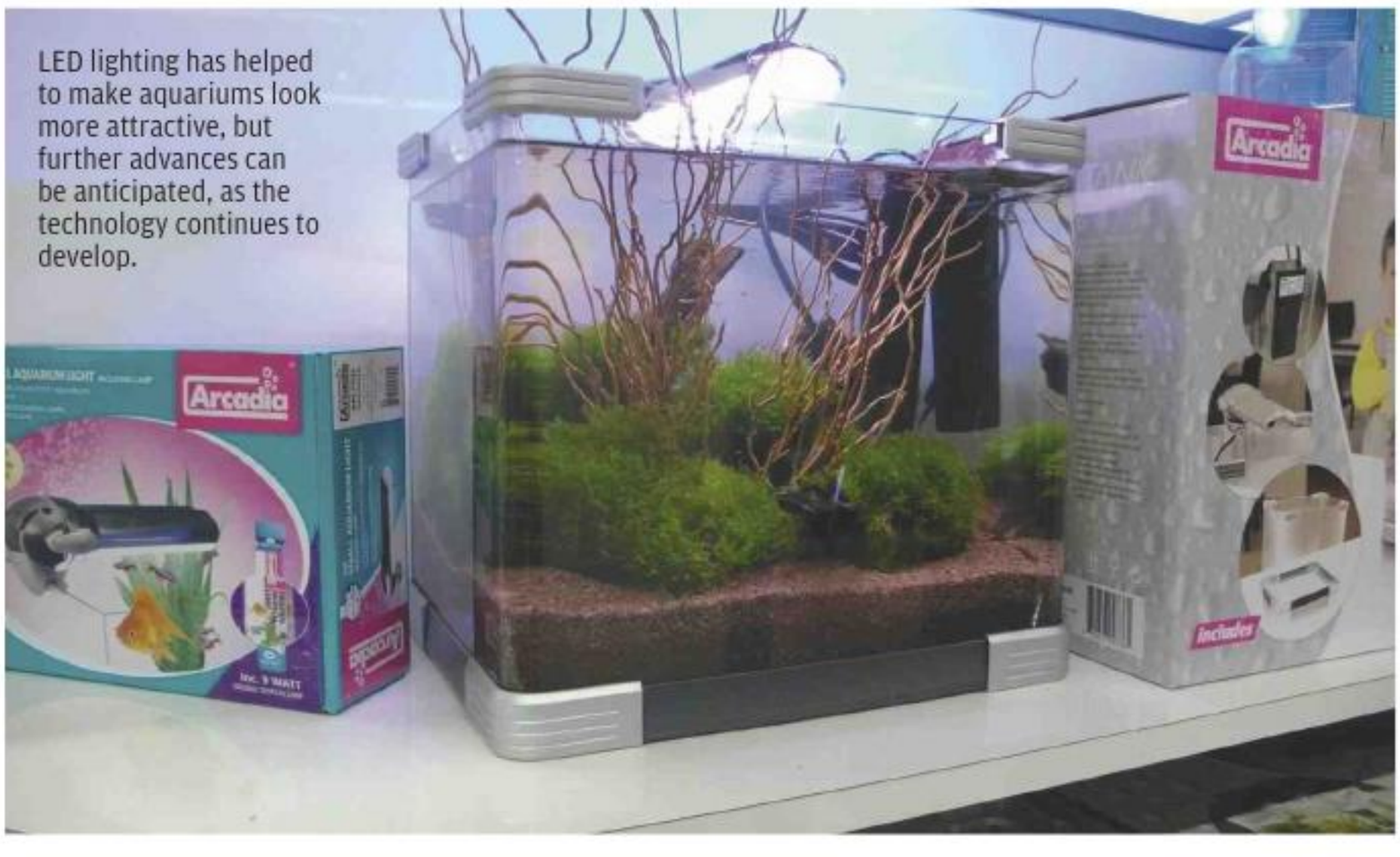
Historically, one of the main concerns about commercial LED systems has been waterproofing the units. For many years now, it has been a legal requirement for lighting companies to sell only totally waterproof light fittings if they are to be fitted to or to touch an aquarium. This is referred to as being IP67 compliant.

It is worth bearing in mind that unfortunately, some fittings that are available on auction sites for example are not waterproof and this does pose an obvious risk to the keeper and fish alike. The Arcadia Classica "Stretch" is a nice example of a fitting that not only provides good tropical or marine colours and affords an excellent level of PAR, but it is sealed with a sealing agent to ensure that it is compliant with IP67.

In conclusion

LEDs have proved to represent a significant advance in terms of aquarium lighting. In many cases, they will reduce running costs, while increasing the amount of visible light, but it is worth emphasising that they still represent an emerging technology. As such, over the next 5-10 years, we are certain to see a massive increase in output and spreads of light, combined with a decrease in the energy used per cell and an extended lifespan for products of this type, which will reduce running costs.

The ability to control such products will increase, and the PAR levels required in individual aquariums will be easier to set. Coming back to the present though, the best advice is to do your research thoroughly before investing in a new system. Make sure that the system that you are looking at is suitable for your needs. You will need to see the spread of light and ensure, that as far as any PAR figures are concerned, this data relates to the figures obtained through water and not through air.



LED lighting has helped to make aquariums look more attractive, but further advances can be anticipated, as the technology continues to develop.

FISH FOCUS

Tetra

Pi Tetra
Leptagoniates pi

Transparent species of fish are well-recognised in various groups, including catfish and glassfish. This characteristic serves as camouflage, enabling such individuals to merge into their backgrounds.

The pi tetra is a relatively new addition to the list, having being described for the first time in 1978, from Bolivia in South America. Its distribution is now known to be wider, as it has also been found in neighbouring Peru, and it probably ranges throughout the Mamoré River basin.

The body organs of the pi tetra are visible through the sides of the body, and this species has been named because of the distinctive and unusual shape of its swim bladder – the organ that is essential in providing the fish's buoyancy, allowing it to swim without difficulty. It resembles that of the Greek letter π in shape, which is commonly referred to as 'pi'.

The appearance of the swim bladder also means they are sometimes called triangle glass tetras, and they may be advertised as mountain crystal tetras too. Although not commonly available, these distinctive fish have proved to be very peaceful by nature, with care requirements that do not differ markedly from those of other small tetras. They need soft, slightly acidic water conditions, with the water temperature being about 25°C (77°F).

Pi tetras are small in size, typically growing no bigger than 4cm (1.6in), and in spite of their lack of colour, they make very striking aquarium occupants. Shy by nature, they should be kept in large shoals comprised of about ten individuals, in a well-planted tank that affords them plenty of cover. They will settle well and soon gain in confidence in these surroundings.

Occupying the mid-water area, suitable companions for these gentle tetras will be hatchetfish that will remain close to the surface, as well as bottom-dwelling corydoras catfish. Crumbled particles of flake food, and small live foods such as daphnia should form the basis of their diet.

"The body organs of the pi tetra are visible through the sides of the body, and this species has been named because of the distinctive and unusual shape of its swim bladder"

Flying foxes and black sharks

A rainbow shark (*Epalzeorhynchos frenatum*)

A group of fish that are not what they seem!

A flying fox.
PHOTO © MAX GIBBS AT THE GOLDFISH BOWL.

Christian Castille reports on these well-known fish that are often recommended for newcomers, and yet very little is actually recorded about them.

Picture this creature. It is described as a fox, but is not a member of the wild dog family, and is said to fly, although it does not do so ….This sounds like the beginning of a bad riddle, doesn't it? Then when I give you the words 'flying fox' as another clue, your first thought is most likely to be of the giant Old World bats belonging to the Pteropodidae family, although of course, in this instance, you would be wrong!

One of my favourites

If nothing else, this makes the case clearly as to why scientific names can be more significant than common names in the animal world. What I'm talking about is a fish that ranks as one of my freshwater aquarium favourites. Popularly known as the flying fox (*Epalzeorhynchos kalopterus*), they are in demand and rightly so, because they have earned their place in the community aquarium. On the other hand, they can sometimes be rather overlooked, as they are not brightly coloured.

When studied closely though, while I think it is hard to link any fish with

Did you know?

The flying fox was first described in 1851, by a Dutch medical doctor called Pieter Bleeker (1819-1878). He was a remarkable man, as reflected by the fact that there are very few families of fish reported during the period when he was working for the Dutch East Indian Army between 1842 and 1860 that do not have his name tied to at least one species of a genus through his discoveries.

being cute, flying foxes seem to come close to managing it! Although their streamlined body is not that different from many other fish of their family Cyprinidae, there is something about flying foxes that can just make you sit down and watch them dart around their tank for hours on end. I've kept these since I had my first ever tropical fish tank over 20 years ago now, and I still even have an adult from that era who is about 18 years old now.

Unfortunately however, it has to be said that many people fail to appreciate the requirements of flying foxes, and so their lifespan is usually very much shorter, with the majority probably living little more than two years on average. I hope that my experiences will therefore encourage you to start out with these fantastic fish, and help them to thrive for many years under your care.

Originating from southern Thailand, Java, Borneo and parts of Sumatra in southeast Asia, the flying fox has declined in many parts of its range, partly because in the past, it was widely caught to supply the pet trade. Today, things have changed significantly, as this species is now being bred on special fish farms in various parts of its native range. Since its breeding habits are still not fully understood though, so this is routinely achieved by adding hormones to the water, in order to induce reproduction.

Similar in looks, but not the same! The Siamese algae-eater needs different care to the flying fox, with the dietary requirements of these fish being different.

Identity problems

The flying fox itself was originally considered to be a barb, being first described as *Barbus kalopterus*. it was later reclassified in the *Epalzeorhynchos* genus. There is little to be told about their entry into scientific literature, except right from those early days, they often seem to have been misidentified as other species, sometimes even deliberately!

This has been partly as a result of ignorance on occasions, but also because it has sometimes suited those selling them. They have been referred to under the scientific names of both the false flying fox (*Garra cambodgiensis*) and the Cambodian logsucker (*G. taeniata*). These species resemble the flying fox to the untrained eye, but if you looked more closely, and can compare these fish alongside this species, you will see that their colouration is not as vivid, nor are they are so streamlined. Rather, their body is shorter yet has a great girth.

Then there is confusion that has grown up with the Siamese algae-eater (*Crossocheilus oblongus*), another unrelated species that also has a similar appearance, although it is less convincing at close quarters. Not only are the differences between the flying fox and the Siamese algae eater more marked, but the latter has a more restricted diet, feeding mainly on algae as its name suggests, plus it is more expensive too.

Unfortunately, this confusion is one of the reasons that flying foxes may not live that long, as they will not thrive on a diet comprised of little more than greenstuff, in the way of algae growing in the aquarium and commercially-available substitute foods of this type. It is entirely misleading to refer to flying foxes as feeding primarily on algae. They certainly will eat this plant matter, but it is not enough to sustain them for any period of time, let alone allow them to breed in aquarium surroundings.

I believe the biggest issue with these fish is they have been sold to unsuspecting aquarists in the past to the extent that any truth about how to keep them correctly has been lost. It has been replaced instead by propaganda that suggests they are incredibly adaptable, and every tank should have one, on the basis of their ability to keep algal growth under control (which should be achieved large by good management anyway!).

It is true that these fish can live communally in tanks, and will thrive in these surroundings, but there are specific parameters that must be met for this to take place successfully. It is these small details are forgotten, with potentially catastrophic results.

Changing needs

When they are young, flying foxes can be kept in a communal tank as they hide a lot, but as they grow, so they become much more aggressive, thanks to their extremely territorial nature. That said, they are peaceful with many smaller species of fish such as tetras and guppies. Nor are they known to be tail-nippers so even the likes of a male betta would be fine in their company. This gives you the impression that they must therefore be suitable to house together, but this can prove to be a fatal assumption for these fish, particularly if their aquarium does not have a wide selection of hiding places.

As they grow older, so flying foxes will begin to defend their retreats from others of their own kind.

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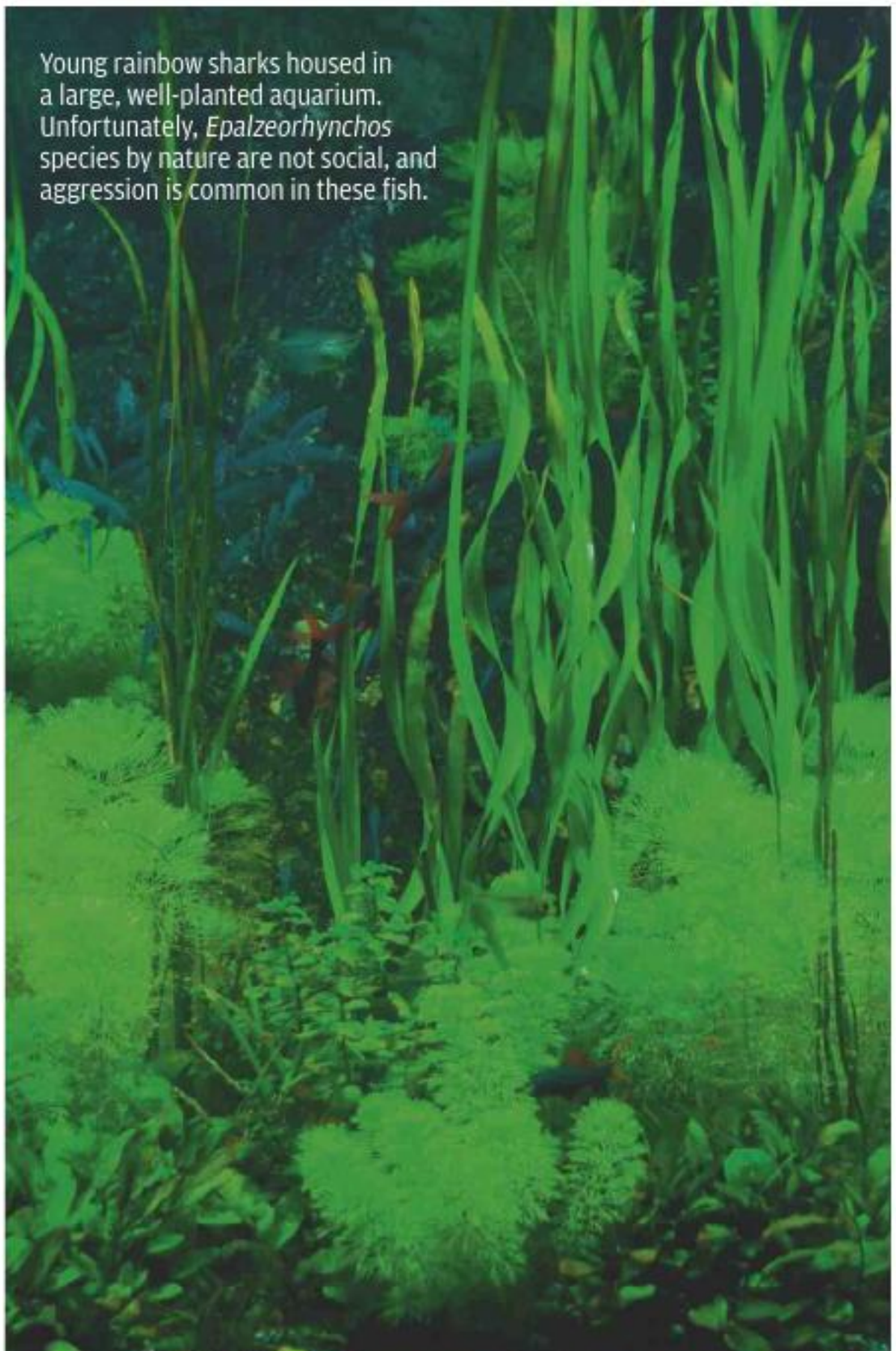
A well-planted aquarium is essential for all *Epalzeorhynchos* species. A red-tailed shark is seen here.
PHOTO COURTESY HRISTO HRISTOV.



Young rainbow sharks housed in a large, well-planted aquarium. Unfortunately, *Epalzeorhynchos* species by nature are not social, and aggression is common in these fish.

"unless you are set on trying to breed your fish, they should only be housed on the basis of one individual per aquarium by the time they are three years old"

Their level of aggression towards each other increases significantly with age. This is why, unless you are set on trying to breed your fish, they should only be housed on the basis of one individual per aquarium by the time they are three years old. Only in a very large, well-planted set-up are you likely to be able to keep more of these fish together with fighting taking place.

In addition, although they are not aggressive with other, totally unrelated fish, flying foxes should not be housed in the company of shrimp, red crabs or African dwarf clawed frogs. They will otherwise persistently harass these creatures, causing them to succumb to stress, even if they do not kill them directly.

I keep flying foxes in communal tanks but I only have a maximum of about three per tank in most cases, supported with a lot of careful aquascaping as well. It is not just a question of plants, but other décor such as rocks and bogwood too, enabling me to create suitable mini-territories within this area for the fish. This is how I managed to breed them.

However when looking after aquatic plants, keeping the water conditions suitable is even more vital than normal. This means adding fertilisers into the water and using other methods such as carbon dioxide (CO^2) to ensure the best possible plant growth in these surroundings.

To be honest therefore, I was not entirely sure whether my breeding success with flying foxes was planned, following the advice of a German breeder, but could have been a result of unintentionally adding solutions that created a reaction that may have triggered increased hormonal production in the fish themselves. At present, I

Livefood such as daphnia can be a good conditioning food for fish, bringing them into breeding condition.

am still not certain, but since breeding these fish in aquarium surroundings is a rare event in any case, I thought it would be useful to give details of my experience.

Breeding success

Sexing flying foxes is very difficult, particularly outside the breeding period. Females are bulkier in profile, but this is still not a foolproof method; since I was keeping three fish in the same tank though, and they spawned successfully, then this does mean that I must have at least one pair.

My successful breeding took place in 2012, by which time these adult fish were over four years of age. They were kept in a 272l (60gal) aquarium filled with live plants, which meant that the water was high in oxygen. Those present included Amazon swordplants, vallisnerias, cryptocorynes and hygrophila. I used UV lighting to help with plant growth, as you would expect.

Feeding plants is very important as they require a balanced range of chemicals for healthy growth. They will naturally take up the nitrate produced from the breakdown of the fish's waste, but need other chemicals too, such as iron and potassium, in order to support their growth. You can obtain special aquarium fertilisers for this purpose, which are safe to use in these surroundings. Carbon dioxide systems are also useful.

Gonadotropin is a hormone used in Asian fish farms to stimulate ovulation in female fish of many species, including flying foxes. It is a protein produced by vertebrates via the anterior pituitary gland in the brain. However, some of these plant supplements that are available contain products that have similar components to fish hormones. My worry has been that my breeding success was actually the result of extracts that I had used to produce good plant growth, rather than my management of the fish directly!

The breeding cycle

The actual breeding, or rather my plan, was rather simple. It was to try and introduce a small number of flying foxes that I had attempted to sex into an aquarium aquascaped as far as possible specifically to meet their needs. I would then light the aquarium for 12 hours every day for a period of three months, and gradually increase the water temperature up to 27°C (80°F) over this period, as I reduced the pH down to around 6.5 from 7.2 where it was normally.

During this time, I also began feed the flying foxes a diet with a much higher level of protein in the form of live insects, to encourage them to hunt for food and become more active at this stage. I hoped that if I had at least one male and one female, then spawning would ultimately take place.

In May, (which was three weeks after I had added more nutrients to the tank water), I noticed what I believed was the female had a swollen abdomen, and it looked like she was ready to spawn. I watched her closely but she never expelled the eggs at this stage.

Three days later, I noticed she had laid, and the believed male was seemingly trying to fertilise the eggs that were on the base of the aquarium. Unfortunately, the other flying fox in the aquarium, as well as the female who had produced the eggs seemed to be eating them.

I therefore removed both of these fish straightaway, and then the male after his work was done. Within just 36 hours, there were a lot of fry visible in the tank. I netted out as many as I could, and placed them in a fry set-up. Out of probably around 100 fry, I managed to rear 20 babies into adults and I still have all of them now.

Yet it wasn't until I attended a fish talk that one of the speakers who works with aquatic plantations mentioned the hormonal ingredients that can be found in some plant nutrients. It was this that made me reconsider as to what precisely had triggered the spawning activity.

Nutritional needs

Feeding these fish is not that different from many other bottom feeders really, but as they are often incorrectly described as algal feeders, this means they frequently do not receive a proper diet, and die prematurely. I provide a mixture of live and prepared invertebrates such as bloodworms, daphnia and even small organisms cultured in outdoor rainwater reserves, but the best food which enhances their colouration seems to be brine shrimp.

CONTINUES ON THE NEXT PAGE »

Barbels around the mouth help these members of the cyprinid family to find their food.

PHOTO © MAX GIBBS AT THE GOLDFISH BOWL.

An unidentified *Epalzeorhynchos* species, reflecting the diversity that exists in colouration between fish from different localities.
PHOTO © MAX GIBBS AT THE GOLDFISH BOWL.

They will also eat a lot of plant matter, with a favourite being chopped-up cucumber. What I do is to soak this in a tub of dechlorinated water for a few days. Otherwise, there is so much air in the slices that they tend to float on the surface, where it will be out of reach of the flying foxes, as well as being potentially problematic for surface-dwellers too, in addition to causing problems with the filtration system.

You need to have the pH reading as neutral as possible, because although they are hardy fish, flying foxes are not big fans of change and they do seem to be very sensitive to any variations in water hardness and pH. As an example, even adding different types of wood into your tank can create buffering effects that may become an issue for them.

Local variations

There is great variation amongst different populations, based on the region where they originated. There also tends to be a slight difference in colouration between wild individuals and those that have been raised commercially.

Those found in the wild often seem to have more red in their pectoral fins, and a pinkish hue on their scales that runs below the black stripes on the sides of their body. It has been suggested that this may be the result of the hormones used in commercial breeding, although this has not been proven.

You are likely to find that there is not as much information on this species as you would have thought, which is surprising since it features in the top 20 most popular tropical fish sold to first-time fish keepers in the USA. There desperately need to be more efforts made to encourage natural captive breeding, as well as better education about how to keep these fish correctly. They face an increasingly uncertain future in the wild, because of habitat destruction, with their populations continuing to fall dramatically.

Red-tailed black shark

The scenario with the flying fox could end up corresponding to that suffered by its relative, the red-tailed black shark (*Epalzeorhynchos bicolor*). It has now become so scarce in its Thai homeland that it is regarded as being almost extinct in the wild.

These are fish that you see regularly in the pet trade, being commercially bred for this purpose, and yet there are literally less than 200 individuals believed to be left in the wild, according to some reports. They are like the Syrian hamster in that they are abundant in our homes, but not in the wild.

Their tall dorsal fin and streamlined profile is highly suggestive of a miniature shark, and this explains their name. Growing to a maximum of about 12cm (4.7in), red-tailed black sharks display attractive contrasts in colouration. They have a matt black body, offset against a bright red caudal (tail) fin.

Red-tailed black sharks are omnivorous in their feeding habits, and will eat most things. Unfortunately though, they are also aggressive fish, particularly with their own kind, but also other fish too, and being unpredictable in

The similarity in profile with a shark can be clearly seen here.

Popular Fish Keeping — Vital statistics

Flying foxes have been known to grow up to around 17cm (6.6in). The largest and oldest individual on record attained 17.1cm (6.73in) in length and lived for 23 years old, being kept in the collection of Swedish aquarist Hans Frecklin. However, they tend to grow more typically to 12cm (4.7in), with 15 years being an average lifespan if their husbandry requirements are adequately met in aquarium surroundings.

this regard means that they are often not suitable for many communal set-ups.

Rainbow sharks

The rainbow shark (*Epalzeorhynchos frenatum*) may at first glance appear to be similar to the red-tailed shark, until you then take closer look at their fins and see that they have red pectoral, pelvic, anal and dorsal fins. There is also a slight yellow sheen to their body scales that can be seen on the lateral line extending down the sides of the body, and they have a lighter coloured head.

Both these species also occur in different colour morphs, with the albino being the most popular. This removes the black colouration, replacing these areas with white but leaving the red fins unchanged. Rainbow sharks can grow to around 14cm (5.5in) and seem to be able to tolerate a slightly higher pH than other members of their genus. They also seem to be more docile when housed with other unrelated fish of similar size, but they are still likely to fight with their own species, particularly in aquariums where there is restricted cover.

The care of these fish is again pretty much identical to that of the flying fox, but they do not seem to be as active, although it has been suggested that they are more lively under cover of darkness.

An example of an albino rainbow shark. Note how the fins retain their red colouration.

The red fin

By far the rarest member of this group in the hobby is the red fin shark (*Epalzeorhynchos munense*). It looks very different from the two previous species, being noticeably grey in terms of its background colour, rather than black. Red fin sharks have a short black stripe that runs across the head, with a pinkish underside to the body and a black blotch of at the base of the tail. Pinkish orange stripes run up their transparent dorsal fin.

These fish are also the smallest of the group, growing to a maximum of about 9cm (3.5in). They generally are mid-level swimmers that only graze the bottom for vegetation and other edible items. They seem to be very peaceful and get on with most species. Just a handful of photos of them seem to exist, and virtually nothing has been documented about their care. From the little that is known, they appear to be quite delicate by nature, compared with their relatives, but they may also rank as being the most beautiful.

A rainbow shark - the most colourful member of the genus.

This is the albino form of the red-tailed black shark.

PHOTO © MAX GIBBS AT THE GOLDFISH BOWL.

in an aquarium for young and old alike. Their torpedo-like bodies help them to move at speed, swimming with great elegance and seemingly little effort.

Feed them correctly, keep them singly, or in small numbers in larger, specially designed aquariums and you could be looking at owning a fish that lives longer than most dogs! For an investment of £3, you certainly get value for money. They are a joy to keep and can represent a welcome trip down memory lane for more experienced enthusiasts, who may well have started out keeping these attractive aquarium occupants.

In conclusion

All of these fish are relatively hardy and attractive to look at, providing many hours of enjoyment

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Discovering killifish

Pseudepiplatys annulatus
PHOTO COURTESY HRISTO HRISTOV.

Killifish are often stunningly beautiful, only grow to a small size, and yet you are unlikely to find them for sale in most aquatic shops. But don't let this put you off! They're generally quite easy to keep, and you even can obtain their eggs to hatch yourself. Steve White of the British Killifish Association introduces this remarkable group of fish, in the first of a series of articles.

Introduction

Killifish, also known as egg-laying toothcarps, are not commonly known to the average fish keeper. Only a small handful of species are occasionally available in some of the more specialised aquatic shops.

This is surprising, as they are a widely distributed and very diverse group of fish. Over 800 species have been described to date, with their range extending across the Americas, Europe, Africa and Asia. Many of them are extremely colourful with dazzling fin shapes too, and rival the colours of some marine fish in their brilliance.

Killifish keeping, however, is an area of the fish keeping hobby that has been largely overlooked in the past, possibly because there is a widespread misconception that killifish are short-lived, as well as being difficult to care for. Whilst this is true for the members of some genera (mainly the annual species which mostly live for a year to 18 months), it is definitely not the case with the majority of killifish that typically

Fundulopanchax amieti "Sud Sanaga"
PHOTO COURTESY BOB MERRITT.

"there is a widespread misconception that killifish are short-lived, as well as being difficult to care for"

Aphyosemion elberti "N'tui"
PHOTO COURTESY BOB MERRITT.

Aphyosemion fulgens
PHOTO COURTESY BOB MERRITT.

Diapteron cyanostictum
PHOTO COURTESY STEVE DAVIDSON.

Aphyosemion congicum
PHOTO COURTESY BOB MERRITT.

have a life expectancy of 2-3 years. Although as with other types of fish, some do require particular water conditions in order to trigger spawning, water chemistry is not too critical as far as keeping most species is concerned.

History of killifish keeping

The first killifish were described over 100 years ago, but it was only in the early 1960s that the killifish hobby really started to become established when some aquarists who were very keen on killies succeeded in forming national associations.

In 1965, the British Killifish Association (the BKA) was founded from a small group of dedicated keepers of these fish. Working in association with national bodies in other countries, knowledge of and distribution of rediscovered and new species occurred. Regular journals were published and distributed, with the BKA journal, known as *Killi-News*, being sent to members every two months and covering a range of killifish-related topics.

The BKA and their fellow associations overseas are dedicated to the study of, propagation of, and publication of knowledge relating to killifish. Scientific names are used when talking about a particular species, to avoid possible confusion, and great care is taken to ensure species are not crossbred to create hybrids, but remain true to the original ancestral stock as they are bred down the generations.

New discoveries and bigger collections of fish are often given codes, until they are formally recognised by science and can be properly named. Records detail where the species was originally found, again with the aim of ensuring there is no inadvertent crossbreeding, and populations remain true.

Fish in the wild

Advances in science such as DNA testing and analysis, coupled with easier travel conditions and access to some of the more remote areas of Africa and South America have resulted in the discovery and description of many new species

Many additional and often distinctive populations of previously recognised species have also been documented over recent years. This has resulted in many colourful killifish entering the hobby for the first time, making it a very exciting period for those interested in this group of fish.

The need to document populations and their origins very carefully has been emphasised by the rapid development that has already occurred and is continuing to take place in parts of Africa and South America. Sadly, return visits to many previously known locations where killifish were to be found a few years ago is now frequently revealing that these habitats no longer exist, and populations of species are being lost.

This is partly a reflection of the biology of these fish. Many killifish, particularly those referred to as annual species, breed in small, temporary seasonal pools. These dry up and are easily lost when development such as road building occurs. Some of these species or populations may now only survive in the hobby, emphasising the need to document the original localities from where they originated as carefully and and accurately as possible.

Housing

Killifish vary in size from about 2.5cm (1in), as typified by the enchanting diminutive clown killifish (*Pseudepiplatys annulatus*), up to a length of about 15cm (6in) in the case of the blue gularis (*Fundulopanchax sjoestedti*). They are therefore

CONTINUES ON THE NEXT PAGE »

Aphyosemion ocellatum
PHOTO COURTESY BOB MERRITT.

Aphyosemion herzogi
PHOTO COURTESY HRISTO HRISTOV.

DID YOU KNOW?

Killifish use their jumping ability to move to a neighbouring pool or reach deeper water when the water level in their existing pool starts to fall to a dangerous level.

not large fish, with the majority averaging between 5-10cm (2-4in) in length.

In the wild, killies are often found in small bodies of water and most are not active swimmers. These characteristics therefore allow smaller species to be housed in relatively small tanks, making them easy to accommodate in the home.

A tank measuring 40x20x20cm (16x8x8in) is quite suitable to house a breeding pair or trio of these fish, or to grow on 6-8 youngsters to near adult size. Some killifish are even suitable for inclusion in a tropical community tank but great care is needed when it comes to selecting compatible companions.

Many serious killifish keepers accommodate their tanks in a specially equipped fish houses, but obviously, this not essential. Building an indoor cabinet arrangement with a series of shelves supported on an outer frame can also be effective, providing an attractive way to display a larger collection in the home.

For the fish keeper who wishes to maintain just a pair or trio of one of the smaller species, then one of today's popular nanotanks will be ideal. You do need to make sure that all tanks have tight fitting lids though, as many killies are escape artists, slipping through the smallest of gaps and sadly, highly prized fish have been lost this way.

"the aim should be to set out and try to create water conditions with a pH resembling that which they would encounter in their natural habitat"

Lighting and aeration

Lighting of tanks for many species of killifish does not need to be very bright, as this will cause the fish to become timid and hide away. It is also important to consider the heat given off by the light, which, above a small volume of water, may well impact on the temperature.

Aeration, while not essential, can be useful in preventing the build up of a film on the water's surface. A modest pump can be used to run a number of small filters and/or air stones to achieve this aim.

Water conditions

Probably the most important element of keeping killifish successfully is the water. Although the ideal is to create the natural water conditions in which the fish are found in the wild, many of these localities are water holes, brooks, rivulets, ponds and temporary pools which are often polluted with waste, which affects the conditions there.

In practice, as far as most species are concerned, the aim should be to set out and try to create water conditions with a pH resembling that which they would encounter in their natural habitat. For many species, water within a pH range of 6.6 to 6.8, and 4-7 on the water hardness dH scale is suitable (although this is not the case for most killifish species found in Eurasia or North America). There are organic and

Fundulopanchax gardneri nigerianum
PHOTO COURTESY BOB MERRITT.

Scriptosemion schmitti "Juarzon"
PHOTO COURTESY BOB MERRITT.

Aphyosemion ogoenese ogoenese
PHOTO COURTESY BOB MERRITT.

Rivulus xiphidius "Crique Boulanger"
PHOTO COURTESY BOB MERRITT.

chemical means of adjusting pH as very few tap waters fall within these parameters.

However, clean rainwater can be used to achieve rapid results. This provides the closest means of mimicking the temporary pools occupied by these fish that are created during the wet season. Water hardness can actually be an important factor in keeping many killifish successfully, particularly if you are hoping to breed them. Rainwater is of course naturally very soft, as it has not run over or through ground that is rich in calcium, which causes hard water conditions.

Temperature and feeding

A water temperature of around 22°C (72°F) is suitable for many species, but some will thrive at lower temperatures. Research by way of species reports and general observation of stock, particularly when feeding, can give an indication as to whether the fish are eating well and appear comfortable.

Killifish are naturally carnivorous, feeding on small invertebrates, but many will take a variety of different types, such as bloodworm and daphnia, grindal worm and brine shrimp. Frozen food will often be readily accepted. Some species will accept flake food and specially formulated food for killies, and you can also culture food such as fruitflies (drosophilia) for them.

Types of killifish

Most killifish fall into one of two categories, which are described as either the annual or non-annual groups. Annual species, such as members of the *Nothobranchius* genus from Africa, and those belonging to the *Austrolebias*, *Simpsonichthys*, *Hypsolebias* and *Ophthalmolebias* genera from South America (to name just a few) are what

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Gnatholebias zonatus finca
PHOTO COURTESY HRISTO HRISTOV.

Simpsonichthys picturatus Ibotirama
PHOTO COURTESY HRISTO HRISTOV.

are referred to in the hobby as 'peat divers'. In the wild, they literally dive into the soft substrate, spawn there and bury their eggs.

The pools where they live then dry up and all the adult fish die. Their eggs, however, remain in the substrate in a state known as diapause, and then months later, when the rains return, so they will hatch. The resulting fry grow rapidly and can often spawn at the age of just five weeks old.

In the wild, the lifespan of these fish is short – being just a matter of months, as it is closely tied-in with the seasons. Their unusual life cycle has given rise to the local belief in some areas that 'it rains fish', as they suddenly appear from nowhere. Nevertheless, in aquarium surroundings, the lifespan of these annual species is much longer, and can extend over several years.

Non-annual killifish include the *Aphyosemion* and *Epiplatys* species of Africa, *Rivulus* and associated genera from South America and *Aphanius* species found in Europe and parts of the Middle East. These egg laying species are easily bred, having a short incubation period (often lasting just a couple of weeks) in permanent bodies of water.

Summary

This article is just a snapshot of the current killifish-keeping hobby, which sadly remains a branch of fish keeping unknown to many aquarists. With the wide spectrum of many beautiful colourful species represented within the hobby though, it really deserves to be more popular.

If you are inspired to know more, visit the new BKA website http://www.bka.webeden.co.uk (parts of which are still under construction) for more information and details of membership.

For a small annual subscription, members have access to the members area of the website and a wealth of information and contacts, in addition to receiving six issues of *Killi-News* per year. At present, the entire archive of *Killi-News* dating back to 1965 is in the course of being uploaded to the site, and it is hoped that this will prove to be an invaluable source of reference. In addition, there are the egg and fish stock lists, details of regional groups, plus events such as members' auctions and much more to be found here.

Chromaphyosemion volcanum
PHOTO COURTESY STEVE DAVIDSON.

Get off to the best start!

Popular Fish Keeping has teamed up with the British Killifish Association to offer an exclusive 50% off the cost of the first year's BKA membership, helping to put you in touch with fellow enthusiasts, obtain stock and benefit from experienced advice. New members will also receive the BKA's bi-monthly club journal, posted to U.K. residents only. All this will cost just £10, instead of £20.

If you prefer or live outside the UK, you can receive the journal in pdf form for just £5 (normally £10). Contact Trevor Wood, 9 Dalton Green Lane, Huddersfield, West Yorkshire, HD5 9YD and quote **PRK1** to benefit from this special rate. Trevor's email address is nothoman99@hotmail.co.uk and payments can be made either by cheque or through Paypal.

The amazing zebra danio

Long-finned examples of the zebra danio are now commonly seen.
PHOTO COURTESY HRISTO HRISTOV.

Victoria Neblik explores the remarkable world of this widely kept member of the Cyprinidae family. You are certain to see these popular fish in a new light after reading her article!

It is no exaggeration to say that the zebra danio or zebrafish (*Danio rerio*) is something of a marvel of fish keeping. As an attractive, hardy, sociable and easy-to-breed community fish, it is quite frankly very difficult to find any faults with it at all! It is also very easily obtained, for although it originated from the Himalayan region, it is now available worldwide in the pet trade and is also a popular subject for scientific study. This has led to several different types of these fish emerging, including a long-finned strain, and, since 2003, genetically modified (GM) strains have been available to fish keepers based in the USA although all such fish are banned in Europe.

Glow-in-the-dark fish

These GM zebrafish are known as "GloFish" (which is a trade-marked brand name) and come in a range of colours from Starfire Red®, Electric Green® and Sunburst Orange® to Cosmic Blue®, Galactic Purple®, and Moonrise Pink™. All of these varieties are fluorescent, which - in this case - means that they convert ultraviolet light into visible light of the various colours.

If this sounds like a freakishly unnatural process, the technical answer basically is that it may have Frankenstein-like overtures, but it is actually represents a subtle scientific advance. The fluorescence itself is an entirely natural phenomenon that was discovered occurring in a wild species of jellyfish back in the 1950s.

The jellyfish in question is an obscure and otherwise unremarkable creature called *Aequoria victoria* that ordinarily emits a distinctive

RIGHT Here are some of the striking and different GloFish® colours that have been created.
PHOTO COURTESY WWW.GLOFISH.COM.

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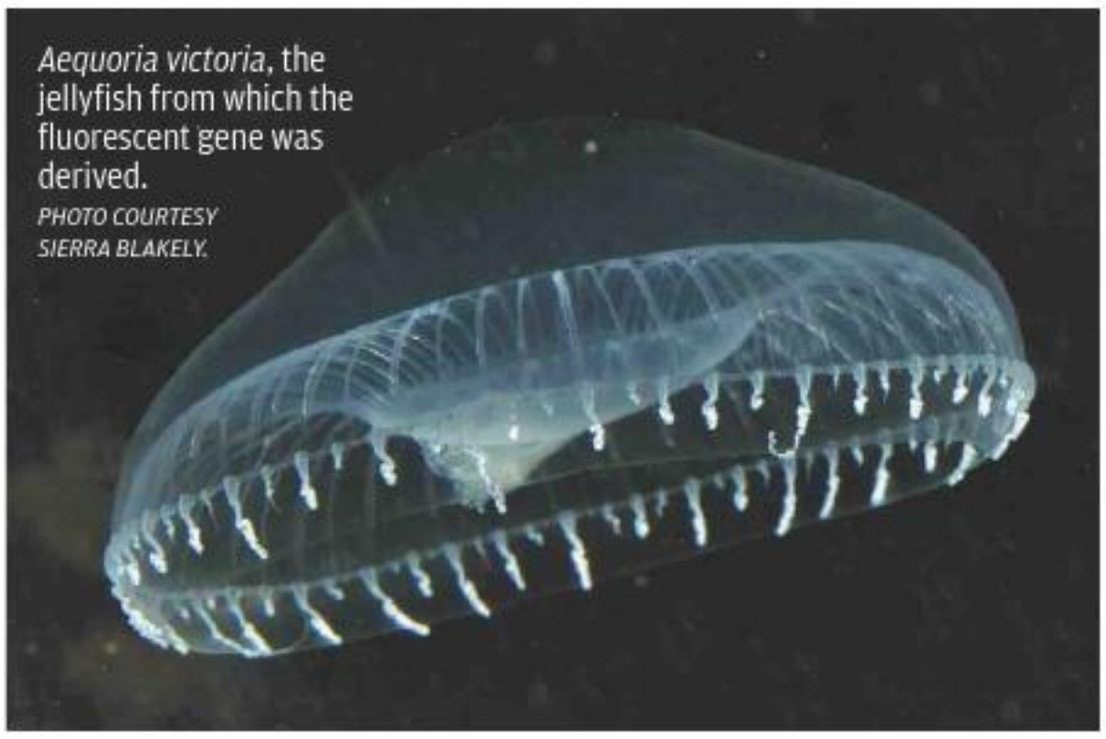
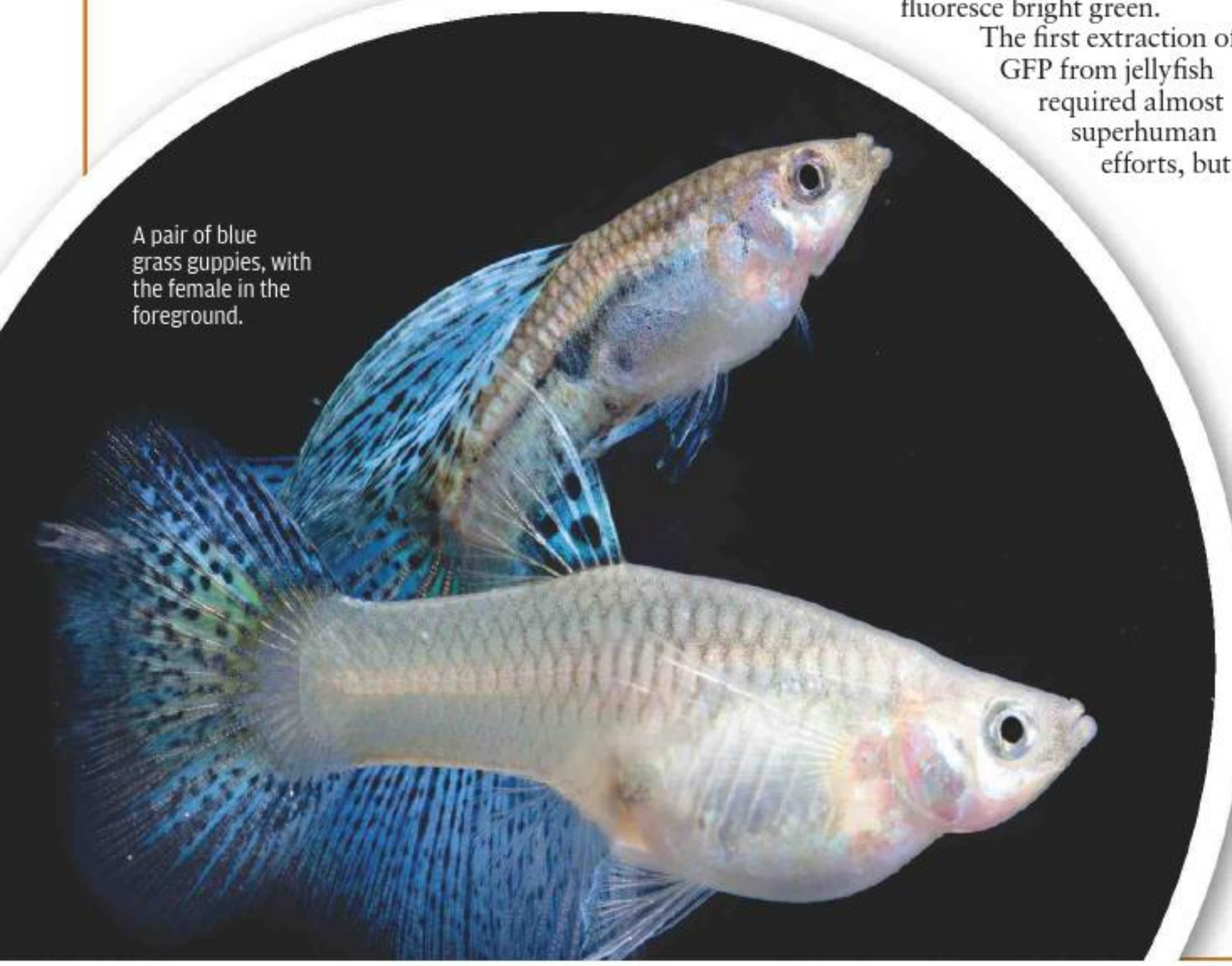


Aequoria victoria, the jellyfish from which the fluorescent gene was derived.
PHOTO COURTESY SIERRA BLAKELY.

ABOVE A sea pansy. These marine invertebrates are often washed up on the coasts of Florida. Living sea pansies light up if disturbed, due to fluorescence and bioluminscence.
PHOTO COURTESY EN.WIKIPEDIA.ORG USER JOB.



A pair of blue grass guppies, with the female in the foreground.

green glow. The glow is the result of ultraviolet (UV) light falling on a naturally occurring green fluorescent protein: a substance that is imaginatively named 'Green Fluorescent Protein', or 'GFP' for short.

Protein markers

Scientists found the discovery of GFP exciting because of its potential as a marker substance. They realised that it could be added to genetically modified cells or animals, along with whatever modified genes they wished to add. If the scientists then wanted to identify the GM cells or animals amongst a crowd of others, the fact that the GM ones would fluoresce under ultraviolet light would reveal immediately which they were.

They also realised that they could also use GFP to study the timing of gene use during an animal's development. If they wanted to know which genes were being used at different times in an animal's development, they just inserted GFP alongside whichever gene they wanted to understand. When the gene was activated, the GFP would be too, and the cells containing them both would fluoresce bright green.

The first extraction of GFP from jellyfish required almost superhuman efforts, but the scientists responsible did, at least, win the Nobel Prize for their work. In later years, similar fluorescent proteins have been found in other organisms, including the sea pansy (*Renilla reniformis*).

Different colours

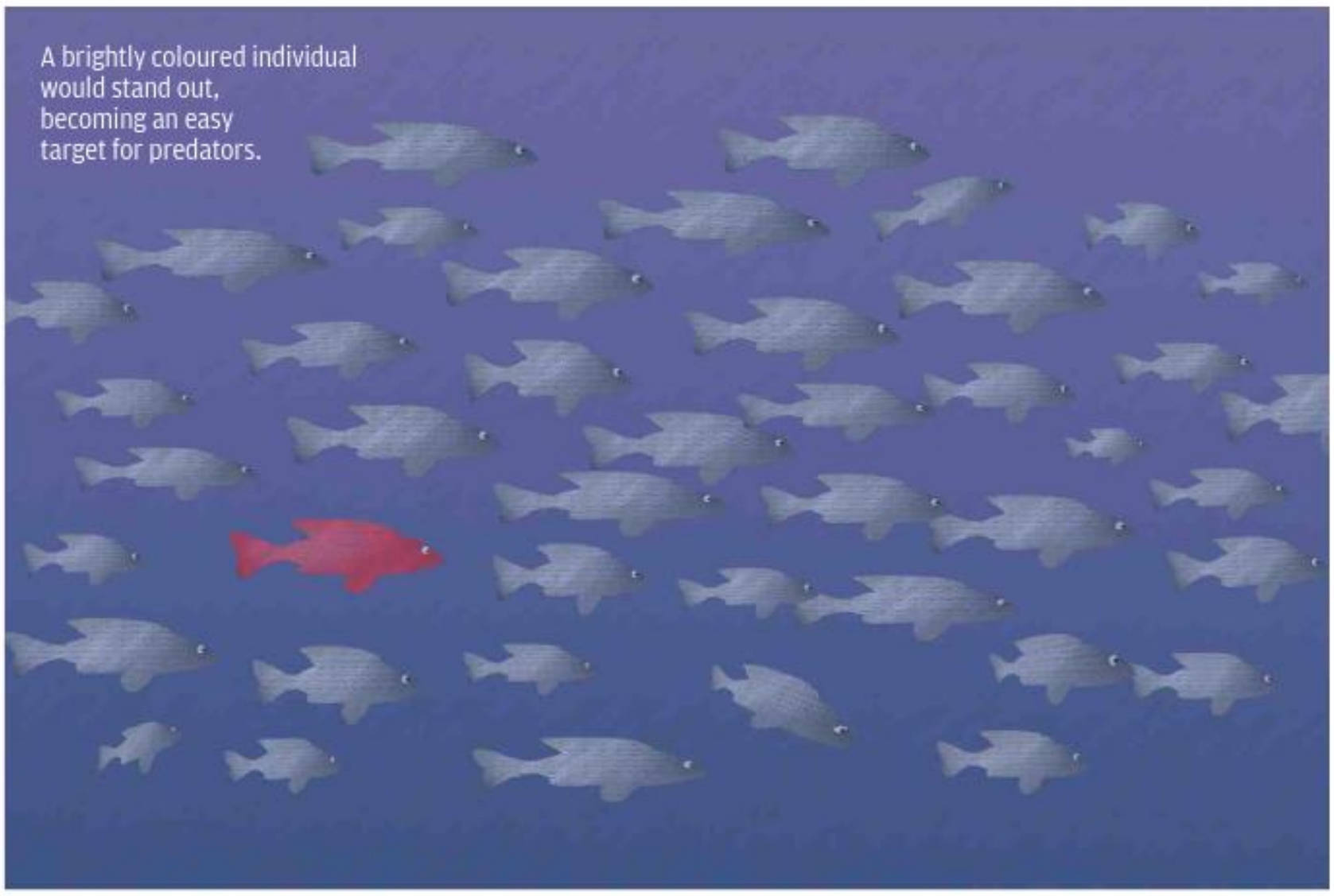
However, not all fluorescent proteins are the same colour. In fact, the precise colours produced by different fluorescent proteins vary, according to the type of protein. More recently, GFP molecules have been mutated in the laboratory to create proteins that fluoresce in notably different hues - from yellow to blue. The GloFish® zebra danios are a reflection of these studies, as they contain a range of fluorescent proteins. In other words, the different colour varieties associated with these particular fish contain different versions of GFP or a related fluorescent protein from another sea creature, which explains their range of colouration.

All of this means that the GloFish® zebra danio has the dubious honour of having been the first genetically modified animal ever to be sold as a pet. It is no longer the only GM pet available in the USA, though, because similarly engineered fluorescent green tiger barbs (*Puntius tetrazona*) now exist. Both pink and orange variants of the black tetra (*Gymnocorymbus ternetzi*) were introduced to the market in 2013.

A controversial project

Clearly these first forays into keeping genetically engineered creatures are quite some way removed from producing an aquatic Jurassic Park, but the first sales of GloFish® zebra danios a decade ago still caused quite a stir. It marked a significant shift in the way people obtain new types of aquarium fish – and pets too. Legally, it also broke new ground, which is why it is possible to buy, keep and breed these fish in the USA but not the European Union.

That said, non-US fish keepers should not feel too aggrieved because the



A brightly coloured individual would stand out, becoming an easy target for predators.

"...a male fish might want the females of his species to notice him, but at the same time, he would rather that potential predators did not!"

GloFish® is not the only form of the zebra danio with interesting colouration. Recent scientific research has shown that standard ("wild type") zebra fish, resembling those that are commonly available in aquarist shops across the world, have the ability to change colour. They display this ability as an indicator of stress and at different times of day, albeit that the changes are a little more subtle than glowing under UV light...

Male or female?

Biologists have long noted that many species have marked differences between the sexes from the lion and the peafowl, right down to the humble guppy. However, in the last few decades, there have been examples of these sexual differences (known as "dimorphisms") being found in animals that were previously thought to have none.

The reason is that these differences can only be picked up under UV light or detected chemically, in the case of pheromones which are chemical messengers released into the environment. Males and females have always been different from one another, but we have never detected these subtle variations, until now.

As far as schooling fish are concerned, there is a definite advantage to blending with other members of the group, because fish that stand out will be eaten by predators at higher rates. This creates something of a paradox: a male fish might want the females of his species to notice him, but at the same time, he would rather that potential predators did not!

Colour studies and shifts

One solution to this problem is for him to display distinctive colouration, but only transiently. The conventional wisdom on zebra danios is that the light stripes of the males are slightly yellower than those of the females, whose corresponding stripes are more silver. However, a recent study by Sophie Hutter, Sarah Zala and colleagues at Vienna's University of Veterinary Medicine has revealed that the true picture is more complicated.

By photographing a total of 62 (male and female) zebra fish at different times of day, the researchers were able to show that both fish of both genders change colour slightly over the course of a day. In the mornings, when spawning occurs in the wild and during spawning itself, they found that the dark and the light stripes of both males and females change shade. This makes the fish more conspicuous and enhances the sexual dimorphism between males and females.

In general, male zebra danios are, indeed, yellower than females, but they are also yellower in the mornings than they are in the evenings.

Detailed discoveries

The study, which was published in the journal *Ethology*, also noted that individual males that appeared more colourful to us were also those that courted females more often than their duller counterparts. The scientists also noticed that wild-type zebra danios were subtly different in colour from laboratory strains. Individual fish taken from laboratory strains were additionally found to be more consistent in appearance to one another than was the case with wild-type fish.

Modern studies of animal colouration ordinarily involve the use of precise instruments, such as spectrometers, to give an accurate wavelength value for the colour observed. A fish would not be described as being "green" for example, but is classified as "reflecting light with a wavelength of 540nm". This is actually problematic with studies of fish though, since accurate spectrometer readings cannot be done underwater and many aquarium fish, including zebra danios, lose their colour and become paler when they are stressed.

If the scientists had handled the fish out of water, these changes would have occurred, in the same way that newly purchased fish can become pale for some hours as they settle into a home aquarium. So in order to avoid this problem, Sophie

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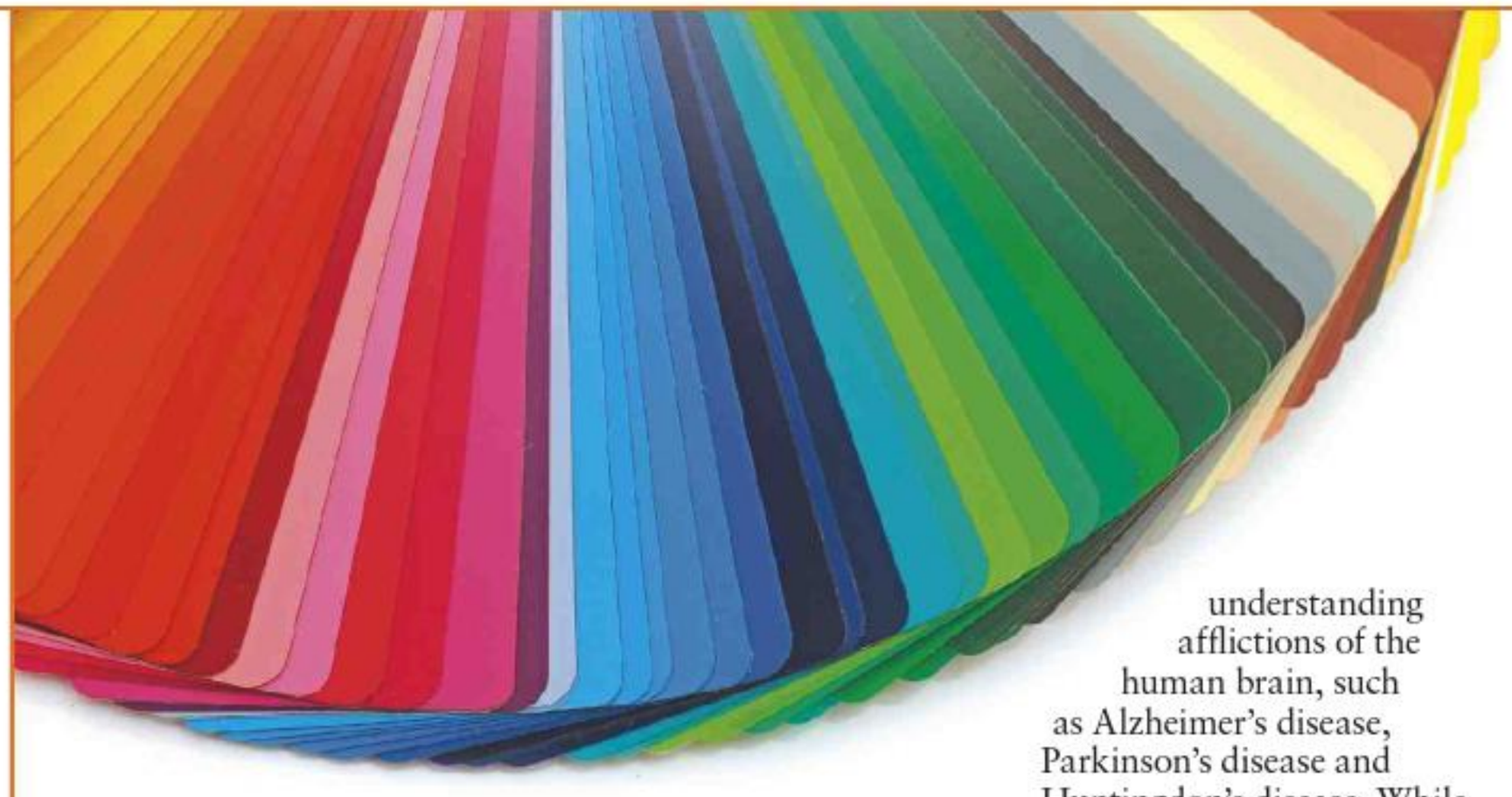
ABOVE The striped patterning of these fish has been shown to be highly significant in communicating with others of their own kind.



ABOVE Spectrometers are used to measure not just the wavelengths of colours, but particular shades of green for example with great accuracy.

Hutter and her colleagues took digital photographs of the fish and then used a spectrometer to compare the printed photographs, allowing the team to reach their conclusions.

A marvel of medical research

Quite aside from its colouration, the zebra danio has several fascinating biological quirks, not least its remarkable powers of regeneration. Adults have an incredible ability to regenerate their fins, skin or heart if any of these organs become damaged. Embryos possess an even more noteworthy attribute though, since they can even regenerate their brain if it is damaged during development.

As a result, zebra danios has become something of a mainstay of many avenues of biological research over the past couple of decades. Embryos of this little fish have been used to study human diseases from cancers to spinal cord injuries and blindness. In 2011, the British Heart Foundation launched an appeal to raise £50 million pounds to fund a project using zebra danios as a way to understand human heart disease.

Other studies have included extensive studies on the genetics of brain development of these fish, in the hope of understanding afflictions of the human brain, such as Alzheimer's disease, Parkinson's disease and Huntingdon's disease. While it is tempting to think that zebra danios would be of little use for solving such problems, one recent review paper explains: "Although there are some notable differences in structure and scale between the zebrafish brain and that of humans, the overall organization shows similarities. Specific regions of the zebrafish brain can be related to...human counterparts" and are often strikingly similar to them.

The review, by Yanwei Xi and colleagues at the University of Ottawa in Canada then goes on to explain that there are known clusters of nerve cells called neurons in the brains of these danios that match those found in the human brain. In other words, there are some very similar nerve cells that develop in very similar ways.

Zebra danio research has helped to understand the role of the "parkin" gene in early onset Parkinson's disease in humans. It has also enabled workers to understand the role of a gene called "BDNF" in Huntington's disease. Both of these sets of discoveries offer hope for new treatments in the future.

Now, while this research is clearly very exciting and worthy, the zebra danio's invaluable contribution to studies of this type does mean that virtually all the research involving these small fish has targeted towards human diseases. For every one study on, say, behaviour, there are a great many more on its use in medicine for mankind.

Recognition

From a fish keeping perspective, this is a pity, because the zebra danio has a number of intriguing biological traits that are entirely unrelated to human medicine. For a start, thanks to research published in 2013, it is clear that these fish can recognise their relatives ("kin") by using a mixture of sight and smell. In an article recently published in the journal *Animal Behaviour*,

Remarkably, the brains of zebra danios are similar to our own.

PHOTO © MAX GIBBS/THE GOLDFISH BOWL.

Imprinting is a phenomenon that is well recognised in certain birds – but not in fish, until recently.

a team of German and US-based scientists studied the details of this process.

The resulting scientific paper by Cornelia Hinz and her colleagues explains that zebra danios learn to recognise their kin in a two-stage process that must involve both vision and smell. The learning effectively results in individual fish of this species becoming "imprinted" with a mental "template" of the appearance and scent of related fish, which they can use to recognise them.

"Imprinting" is generally associated with newly hatched chickens and geese, which will form an attachment to any moving object that they see during a certain critical period shortly after hatching. They then, famously, follow that moving object around, regardless of whether it is indeed the mother bird, or a person, an animal, or even a moving toy train set, as has been documented in one case.

More generally, though, the term "imprinting" applies to any form of rapid, inflexible, learning that occurs during a critical time period or life stage. In developing zebra danios, the critical window for the fish to become "imprinted" on the scent of their kin is a 24 hour period during the sixth day of their development. It really is that precise. That is to say, six days after a egg of a zebra danio is fertilised, the developing larva is imprinting on the smells of related fish around it.

However, if that were not a strange enough idea, the recent study by Cornelia Hinz and her co-workers demonstrated that the developing zebra danios only imprint on the scent of related fish if they have been exposed to the sight of related fish, and this sight of related fish must occur even earlier - typically four, or, more generally, five days after fertilisation.

These complex findings were the result of an equally complex series of experiments, in which the scientists exposed groups of developing zebra danios to different combinations of the scent and/or sight of their relatives and to the same combinations in the case of unrelated individuals of this species.

Glass partitions were used to allow developing zebra danios to see related fish in some of the test groups, whilst frosted glass was used to prevent such visual contact occurring in other cases. The scent of either related or unrelated zebra danios was conveyed to the fish being tested by adding water in which these particular fish had been swimming to the tanks of the test fish.

Certainly not bird-brained!

One curious finding was that, regardless of the set-up and timings, the developing zebra danios never imprinted upon unrelated fish. They either imprinted on relatives or did not imprint on anything at all. This unexpected result led the scientists to suggest that genetics may somehow also be involved.

In other words, zebra danios may be genetically predisposed in some way to identify with their kin. The scientists go on to suggest that the fact that their young require both visual and scent cues to become imprinted may be an adaptation that has a fail-safe, ensuring they do not pick up and imprint on the wrong cues.

This is clearly a clever system and one with obvious benefits; humans and model train-sets might well confuse hatchling chickens and geese, but they would not have the same effect on zebra danios. Their powers of recognition are more sophisticated and refined. All of which goes to show that, whether your zebra danios glow in the dark or have a more conventional appearance, they really are remarkable creatures!

Info point

Dr Victoria Neblik is a writer and previously worked as a research biologist; her website is victorianeblik.com and her books include *Where Flowers Bloom*.

Information on genetically modified "GloFish"(TM) can be found on http://www.glofish.com/about/faq/ and some background information can be found in "Green fluorescent protein (GFP) transgenic fish and their applications" by Z. Gong, B. Ju and H. Wan, which was published in the journal *Genetica* in the year 2001, (Volume 111, Issue 1-3, pages 213-225),

"Ephemeral Sexual Dichromatism in Zebrafish (*Danio rerio*)" by Sophie Hutter, Attila Hettyey, Dustin J. Penn & Sarah M. Zala was published in *Ethology*, Volume 118, pages 1208-1218 (September 2012).

"Modelling Neurodegeneration in Zebrafish" by Yanwei Xi, Sandra Nobel and Marc Ekker appeared in *Current Neurology and Neuroscience Reports*, Volume 11, pages 274-282 (2011),

"Kin recognition in Zebrafish, *Danio rerio*, is based on imprinting on olfactory and visual stimulation" by Cornelia Hinz, Simon Kobbenbring, Sigrid Kress and colleagues was published in *Animal Behaviour*, May 2013 edition, Volume 85, Issue 5, pages 925-930; the abstract is available online at http://dx.doi.org/10.1016/j.anbehav.2013.02.010

Introducing the amphibian that acted as a stork – and more!

Many fishkeepers have more than one tank, and if you have a spare set-up and would like to try your hand at keeping something different, then why not consider the African clawed frog - also known as xenopus? There is also the option of its smaller cousin, which is even easier to accommodate. **Don Harper** reveals more.

African clawed frogs (*Xenopus laevis*) have played a very significant part in medical science down the years. They have advanced our understanding of embryology, helping scientists to understand how organisms develop, but they are still probably better-known today for the part they played in pregnancy diagnosis. This came about as a result of the finding that injecting urine from pregnant women into female African clawed frogs would cause the amphibians to ovulate.

Tanks housing African clawed frogs became a common sight in hospitals throughout the country as a result, since xenopus (pronounced 'zee-NA-pus') then provided the only effective means of confirming pregnancies through until the 1950s. Here in the UK, some escaped, however, and there is a small population of xenopus whose origins date back to this era, which can be found at a locality in Wales, near Swansea.

In the wild

The African clawed frog, whose scientific name has been converted into its alternative common name of xenopus, is most common in southern parts of the African continent, although it does range as far north as Nigeria in the north-west and Sudan in the east. These frogs live in stagnant stretches of water, such as ditches and lakes, and are almost entirely aquatic. Even if the water level falls dramatically, they are more likely to retreat into the mud and await the return of the rains than to seek alternative habitat elsewhere, as they can easily become dessicated when on land.

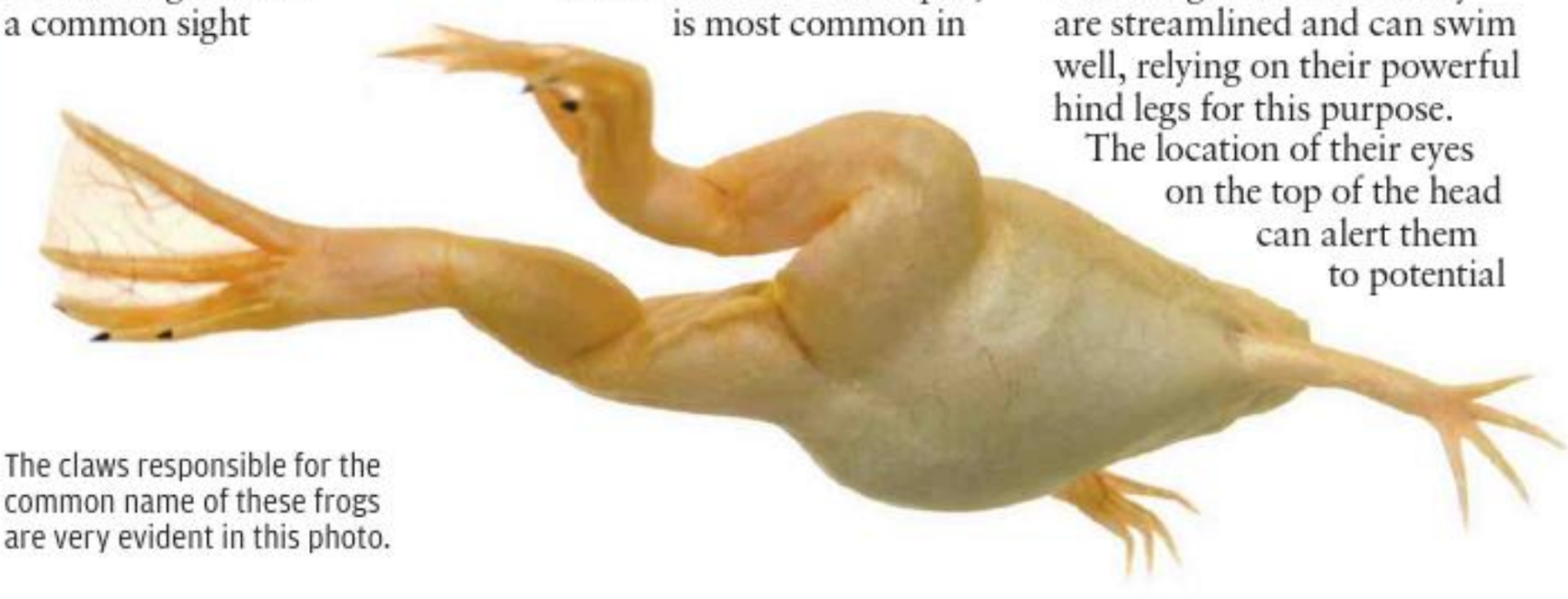
Senses

The flattened body shape of these frogs means that they are streamlined and can swim well, relying on their powerful hind legs for this purpose.

The location of their eyes on the top of the head can alert them to potential predators above, and this is why they are likely to start swimming immediately that you approach their quarters. They have good eyesight, and are well-adapted to spot potential predators looming over them.

The positioning of the nostrils on top of the head is also significant. These will pick up the scent of food, enabling the frogs to recognise edible items, whether or not these are alive. Most frogs in contrast rely on movement to detect prey, and ignore inanimate items. This feature of xenopus biology has meant that it has been possible to create pelleted foods for them, which has greatly facilitated their ease of care in laboratories – and in the home aquariums!

It should be possible to obtain a source of such pellets for pet African clawed frogs too. This is a major plus for some would-be owners, who are put off keeping amphibians by the need to supply them with invetrtebrates of various types.



The claws responsible for the common name of these frogs are very evident in this photo.

Right The streamlined, flattened body shape of these frogs enables them to swim efficiently.

Better still, these pelleted diets are carefully formulated to keep these frogs in the very best of health, and have proved to be highly palatable.

Hearing is also an important sense for African clawed frogs, helping them to navigate in the murky, muddy waters where they typically occur. It also can enable them to find mates.

In terms of size, males are decidedly smaller than females, which can measure up to 15cm (6in) overall. In addition, only males will develop the characteristic swellings, called nuptial pads, on their front legs when ready to spawn.

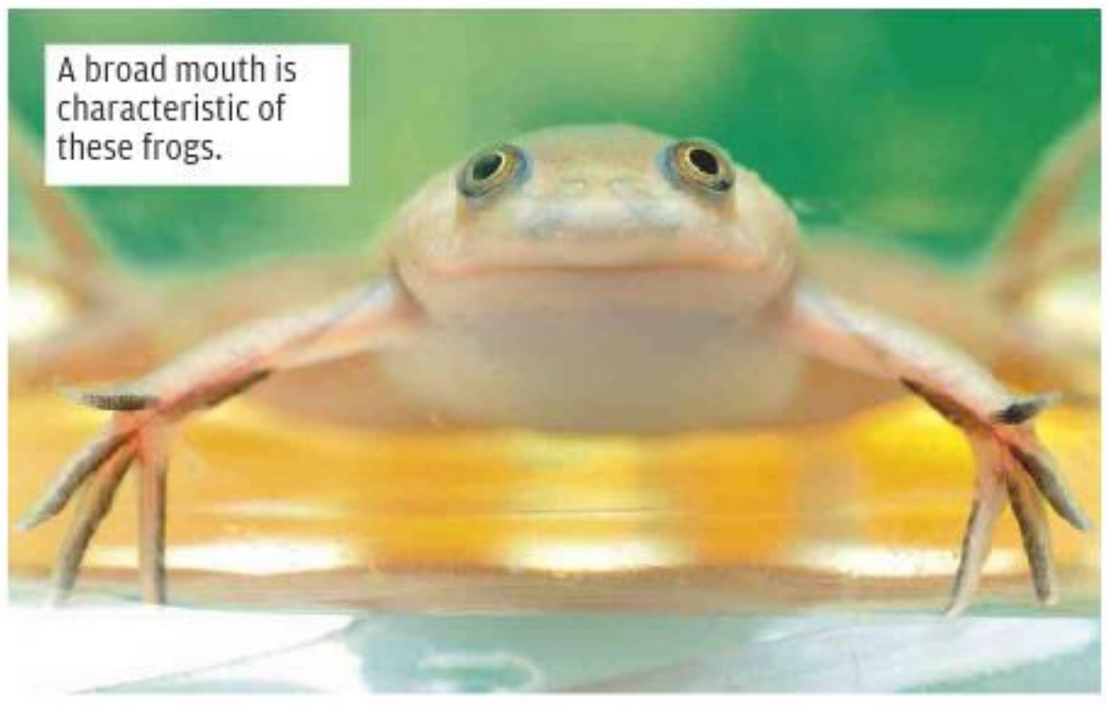
Colour forms

The normal wild form of the African clawed frog is dark greyish-brown with a lighter reticulated patterning over the body and whitish underparts. They are relatively dull in appearance, and certainly as far as the pet market is concerned, the red-eyed albino variant has become much more popular over recent years.

Their bodies are pinkish-white, with a more discernible yellowish caste over the back. A variation on this theme is provided by albinos. They display the typical reticulated patterning over the back. This is highly individual, and allows individuals to be distinguished easily.

Pale variants have become popular today.

A flattened body shape, prominent nostrils and eyes characterise these frogs, with their colouration helping them to blend into the background. This is a rare Ugandan relative of the African clawed frog, photographed in the wild.



A broad mouth is characteristic of these frogs.

Accommodation and care

Housing xenopus is quite straightforward, and they can live for as long as 15 years, provided that a few simple rules are followed. They need a relatively large floor space in their aquarium, and this is far more significant than height. In fact, long, low tanks are preferable, simply because these frogs will come up to the water surface frequently in order to breathe.

The base of their tank can be bare, which prevents any build-up of debris that could threaten the occupants' health, or alternatively, you can decorate it with large stones which will be too big for the frogs to swallow. Aquarium sand is another possibility, as this tends not to cause a intestinal blockage if accidentally ingested, unlike gravel.

African clawed frogs are shy amphibians by nature, and do not require bright lighting above their quarters. What is essential, however, will be retreats where they can hide away. Including plants is not usually very satisfactory though, because the very physical way in which these frogs swim, particularly within the confines of an aquarium, means that living plants in their quarters will be constantly uprooted.

A much better solution, which can also help to make the frogs less nervous, will be to include some floating plants such as duckweed at the water's surface. Especially if the aquarium is well-lit, duckweed will spread rapidly here.

If pellets are not available, a wide range of other foods are suitable, including Tetra's Reptomin, which is more commonly recommended for

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turtles and well-balanced with vitamins and minerals. There is very little that is edible that xenopus will not eat. Earthworms, bloodworms as sold for aquarium fish, and even mosquito larvae can be used, depending on the size of the frogs.

Adults should only be fed two or three times a week, whereas young need feeding daily. They use their long front 'fingers' to handle their food and direct it to their mouth, having no tongue for this purpose. It is very important not to overfeed the frogs, as any uneaten food will pollute the water.

Filtration in their aquarium is to be recommended in any event, with a power filter being a possibility, although these frogs prefer relatively still water. A simple sponge filter can therefore be the better option.

Carry out partial water changes every week or so, replacing water that you bale out with fresh tapwater at the same temperature, that, as always, has been treated with a water conditioner beforehand. This serves to neutralise potentially deadly chlorine and chloramine that is present in tapwater. A gravel cleaner can be useful to remove debris from the floor of the tank.

Supplementary heating may not be necessary for xenopus though. They require a temperature in the range of 20-26°C (76-78°F). Avoid using an aquarium heater, even with a heat shield, as the frog's long toes may be burnt if it rests on it. A heating pad outside the tank connected to a thermostat is a much safer option if additional heating is required.

Right The powerfully muscled hind legs provide African clawed frogs with their propulsive power.

Back from the dead!

African clawed frogs are great escapologists, and for this reason, their quarters must be kept covered. If one does escape however, it will be very important to track it down in the home before it becomes fatally dessicated.

Should you rediscover it and the frog appears dead though, do not immediately fear the worst. Place the frog in a shallow container of dechlorinated water and leave it here for several hours to see if there are any signs of life. If so, keep it in shallow water so it can breathe easily until it is fully recovered.

Breeding

The male becomes quite vocal during courtship, and the female will swell with eggs at this stage. He clasps her around her hindquarters, fertilising the eggs as they are laid. The individual eggs are surprisingly large, and a typical spawning will consist of 500-1000 eggs. They will need to be fished out of the tank using a net as soon as possible afterwards, and transferred to a separate set-up for hatching. If left, the spawn will soon be eaten by the adult frogs.

Rearing the tadpoles presents no great problems, but they must not be overcrowded, and good water conditions are essential. Separate them into smaller batches of similar size as they grow older, as the young are carnivorous. Metamorphosis takes between two to three months on average. Males can then usually breed from a year onwards, although it may be two years before females spawn for the first time.

Smaller relatives

Dwarf African clawed frogs (*Hymenochirus boettgeri*), growing to about 3.5cm (1.5in), have become very popular in recent years. They are very similar in their needs to xenopus, which they resemble in appearance. They are almost entirely aquatic, as reflected by their streamlined, flattened body shape. These frogs also have muscular hind legs and webbed feet that assist their swimming abilities. Originating from parts of West Africa, the dwarf species is now being commonly bred. There is a well-established albino form,

A young male dwarf African clawed frog. Their typical lifespan is probably between 5-10 years.
PHOTO COURTESY STUART HALLIDAY.

"It is preferable not to keep them in the company of fish though, which may snap at their toes, while the frogs themselves may in turn eat small fish."

All clawed frogs tend to stay close to the base of the tank.

with red eyes, as well as the traditional grey form.

Housing

They need to be kept in heated water, with the thermostatic setting being kept at approximately 25°C (77°F). An aquarium heaterstat can be used for this purpose, although this must be shielded with a suitable heater guard, to prevent the frogs from burning themselves on the heater component. But a better option can be to use a heat pad under thermostatic control, especially if you are intending to breed them. This is because the water level will need to be lowered significantly, making it hard to accommodate a traditional heaterstat.

An undergravel filter is also to be recommended, to maintain water quality, with suitable decor being positioned in the aquarium to provide the frogs with retreats. Unlike their larger relative, the dwarf African clawed frog will not prove disruptive in a planted aquarium. The water depth should be kept quite low, about 25cm (10in) on average, and there must be rockwork or other decor allowing them to climb out of the water occasionally, as well as some floating plants on the surface.

These clawed frogs are not aggressive by nature, and groups of up to eight can be housed in a aquarium measuring 60cm (24in) long. It is preferable not to keep them in the company of fish though, which may snap at their toes, while the frogs themselves may in turn eat small fish. Feeding is generally straightforward, with small water creatures such as tubifex worms, bloodworms and daphnia forming the basis of their diet.

General care

Carry out partial water changes frequently, to ensure that the water does not become polluted by wasted food. It is much better to feed small amounts several times each day for this reason. Whenever carrying out a water change, treat the fresh water first with a conditioner, to remove chlorine compounds here.

You then need to ensure that it is at the same temperature as that within the tank, before carefully pouring it in here. When they metamorphose after about six weeks, the young dwarf African clawed frogs will be barely 0.5in (1.25cm) long, but should continue to grow quickly.

Good hygiene rules!

Always dispose of dirty water from the tank down an external drain, and never by tipping it down the sink, and wash your hands thoroughly after attending to the needs of these frogs, as there may be unpleasant bacteria in the water. It is also a good idea to wear disposable gloves when attending to their needs, especially if you have any cuts on your hands.

Webbing between the toes helps these aquatic frogs to swim well. SOURCE PD.

Breeding

Sexing is not easy, unless the frogs are in breeding condition. At this stage, the females will swell with eggs, while the males will start calling. The water level in their quarters should be dramatically lowered, down to just 7.5cm (3in), for up to a month, and then topped up again with slightly warmer water, heated to 30°C (85°F).

Males grab the females around their hindquarters when mating, with the eggs being fertilised as they are laid. The adults must be removed at this stage, before they eat the eggs that will start hatching up to six days later.

Rearing the tiny tadpoles can be achieved if you have access to unpolluted pond water, containing tiny protozoans and other small live foods. Alternatively, you can buy special tadpole-rearing foods, and sprinkle powdered tropical fish flake food on the surface for them as well.

Turning up like a bad blenny?

The Asian stinging catfish has been introduced to the Shatt-al-Arab river. *PHOTO COURTESY MAXIM GAVRILYUK.*

Fish have developed a range of ways to protect themselves, but few have a venomous bite. **Dr Karl Shuker** investigates a Middle Eastern mystery where a fish's bite has been blamed for the death of a number of people.

The Shatt-al-Arab is a river formed by the confluence of the Tigris and Euphrates rivers in the southern Iraq town of Al-Qurnah. It then flows southwards for some 200km (125ml), forming the physical border between Iraq and Iran, before emptying into the Persian Gulf. Many species of fish inhabit its waters, but one of them may be a notable species that is still unknown to science.

A deadly reputation

I first learnt of this small but potentially significant unidentified freshwater fish many years ago, when reading *Dangerous To Man*, Roger Caras's definitive book on creatures that are harmful to humans, but the mystery surrounding it still remains unsolved to this day. In his book, which was published in 1975, Caras included the following brief but very intriguing paragraph:

"From Tehran comes a report of a diminutive black fish found in the Shatt al Arab River. It reputedly has killed twenty-eight people with a venomous bite. Death is said to be swift. No other information is presently available. (No other fish is known to have a venomous bite, and this report is at least suspect.)"

What makes the above snippet so interesting, apart from the fact that except for my own research, I have never encountered anything more about this creature anywhere, is Caras's claim that it is the bite that is venomous and that no other fish is known to have a venomous bite. In contrast though, a wide range of species possess venomous spines, for instance, or toxin-secreting skin. But if we assume that such a fish does indeed exist, what could it be, and how can its reputedly venomous nature be explained?

One suggested possibility

When I originally read Caras's report, the first candidate that came to mind, for several reasons, was the Asian stinging catfish (*Heteropneustes* [formerly called *Saccobranchus*] *fossilis*). This species does indeed inhabit the Shatt-al-Arab (though it is an introduced rather than a native fish there). Moreover, it is often only around 10cm (4in) long, although it can grow up to 30cm (12in). This catfish is

Al-Qurnah lies about 74km (46ml) to the north-west of Basra, marking the start of the Shatt-al-Arab river. *SOURCE PD.*

definitely black in colour, and, of particular significance, is the fact that it is known to be venomous. So far so good! However, unlike the mystery fish from the Shatt-al-Arab waterway, the Asian

A view of the Shatt-al-Arab river. *SOURCE PD.*

The slender moray eel does venture into estuaries and further up rivers on occasions.

stinging catfish is venomous not because it possesses a toxic bite, but thanks to a poison gland that lies at the base of a spine on each of its pectoral fins. This can inflict an extremely painful although not fatal sting. Consequently, even if victims (or onlookers) were mistaken in assuming that this catfish had bitten them, they would be unlikely to die unless they were unfortunate enough to suffer a severe allergic reaction. It is of course possible that they may have been bitten, but even if this had occurred, then this would not have been a source of venom.

Ocean invaders

A second candidate is the long-tailed or slender giant moray eel (*Strophidon sathete* aka *Thyrsoidea macrura*). Although typically a marine species, and distributed widely in the tropical Indo-Pacific Ocean, it is well known for entering estuaries and travelling considerable distances up rivers, including the Shatt-al-Arab. What is particularly interesting about this species in relation to the latter river's mystery fish is that in a sense, it can be said to have a toxic bite, albeit not in a typical fashion. True, its teeth do not actually secrete a toxin, via poison sacs, like venomous reptiles do. However, as a voracious carnivore, the long-tailed moray eel will certainly have pieces of rotting flesh left over from previous meals that are packed with pathogenic bacteria. These stick to its teeth, as in the case of crocodiles and carnivorous mammals. Consequently, a bite from this fish might well transfer some of those bacteria into the wound caused by the teeth, which in turn can lead to septicaemia developing. This is especially likely in someone with a less than robust immune system, such as a child, an elderly person, or someone recovering from a major illness, and particularly in the absence of any medical attention. Even so, no known human fatalities resulting from a bite by this moray eel species are on record, and there is also the not inconsiderable problem of the difference in size that needs to be reconciled. It can attain a maximum length of up to 4m (13ft) when fully grown, making it the longest of this group of fish, although its average length is about 70cm (28in). So this species can hardly be deemed 'diminutive', when compared with reports of the Shatt-al-Arab mystery fish. Nor can the bull shark (*Carcharhinus leucas*), averaging 2.3m (7.5ft) long. Unlike most sharks, this notably aggressive species is frequently found in freshwater habitats, including the Shatt-al-Arab River, and like those

RIGHT The bull shark possesses a formidable array of teeth, but is not venomous.

TURN OVER FOR MORE FISH MYSTERIES »

of moray eels, its fearsome teeth are brimming with pathogenic bacteria from pieces of rotting food still attached from earlier meals. Once again, a bite from this fish, although not intrinsically venomous, might well lead to blood poisoning. And several human deaths caused by this fish attacking them have been confirmed in this stretch of water. But as even a newborn bull shark is normally around 80cm (32in) long, so this species seemingly has no bearing upon the identity of the Shatt-al-Arab mystery fish.

An initial error

As I researched further into this ichthyological puzzle, I discovered one crucial aspect of Caras's account that was fundamentally incorrect. Contrary to his statement, some fish do possess a genuinely venomous bite. And one of these is the blackline fang blenny (*Meiacanthus nigrolineatus*). Its lower jaw bears sizeable canine teeth that have grooved sides and venom-producing tissue at their base. These teeth enable it to produce a sufficiently unpleasant bite to deter all predatory fishes, both large and small. In general appearance, it is relatively nondescript – no more than 9.5cm (3.75in) long, having a blue-grey head and foreparts, with the remainder of its body being pale yellow. There is also a thin black stripe running lengthwise just beneath its dorsal fin, which gives this species its common name.

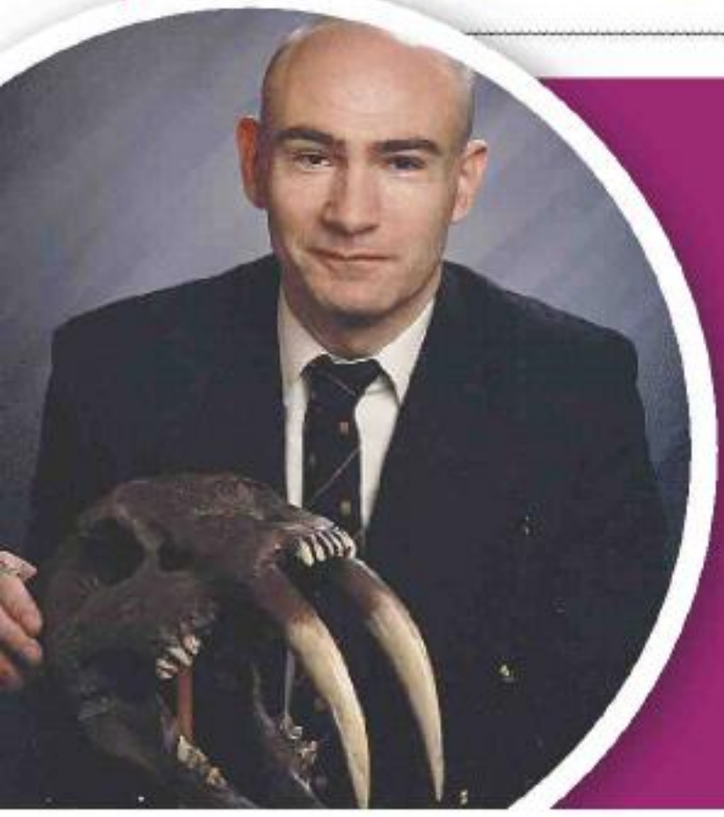
ABOVE
Blennies are relatively small and secretive fish. This blackline fang blenny is partially hidden in the entrance to a tube sponge.

Formidable teeth with venom protect these small fish. A striped fang blenny is seen here, partially concealed in the neck of an encrusted bottle.

A freshwater blenny. *PHOTO COURTESY OLIVIER CROISSANT.*

A possible identity

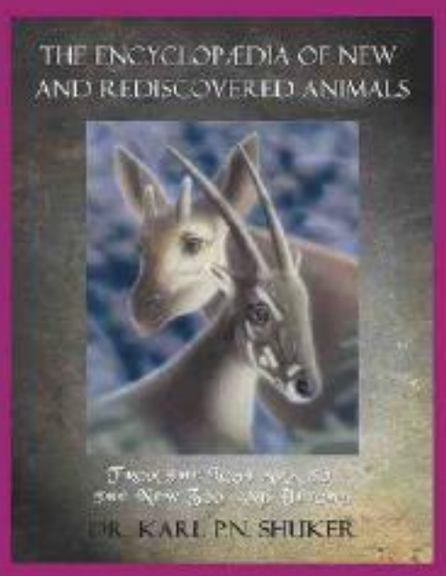
Over 830 species of true blenny or blennioid are currently known to science. They are generally small in size and scaleless, but possess many teeth in their jaws, and have a worldwide distribution. Most are marine fish, as indeed is the blackline fang blenny itself, which is native to the Red Sea, the Gulf of Suez and Aqaba. However, there are freshwater species too, such as the aptly named freshwater blenny (*Salaria fluviatilis*). This fish is native to rivers in several European countries, as well as being found in Morocco, Algeria, Israel and Turkey. What if an undescribed, dark-coloured but otherwise comparable freshwater relative of *M. nigrolineatus* existed in the Shatt-al-Arab River, known locally but attracting little notice from the outside, scientific world? Such a small fish could provide a very satisfactory identity for this river's small yet venomous mystery species. The only conclusive way to solve this riddle, of course, is to capture a specimen and submit it to formal scientific examination. Until then, all that I can do is offer a blenny for your thoughts!



Read up on more fish mysteries

Expert in new species

Dr Karl Shuker BSc PhD FRES FZS is a zoologist, author and broadcaster who is pre-eminent in the field of both newly-discovered species and cryptozoology – the study of animals whose existence is not proven. Read his regular column in each issue, delving into the mysteries surrounding the discovery of various freshwater fish.



A great read

Karl's latest book - *The Encyclopaedia of New and Rediscovered Animals* (Coachwhip Publications: Landisville, 2012) extends to 370 pages long and is packed throughout with rare colour and b/w photographs. It costs £24.95, is available in hardback from Amazon and can also be ordered through all good bookshops.

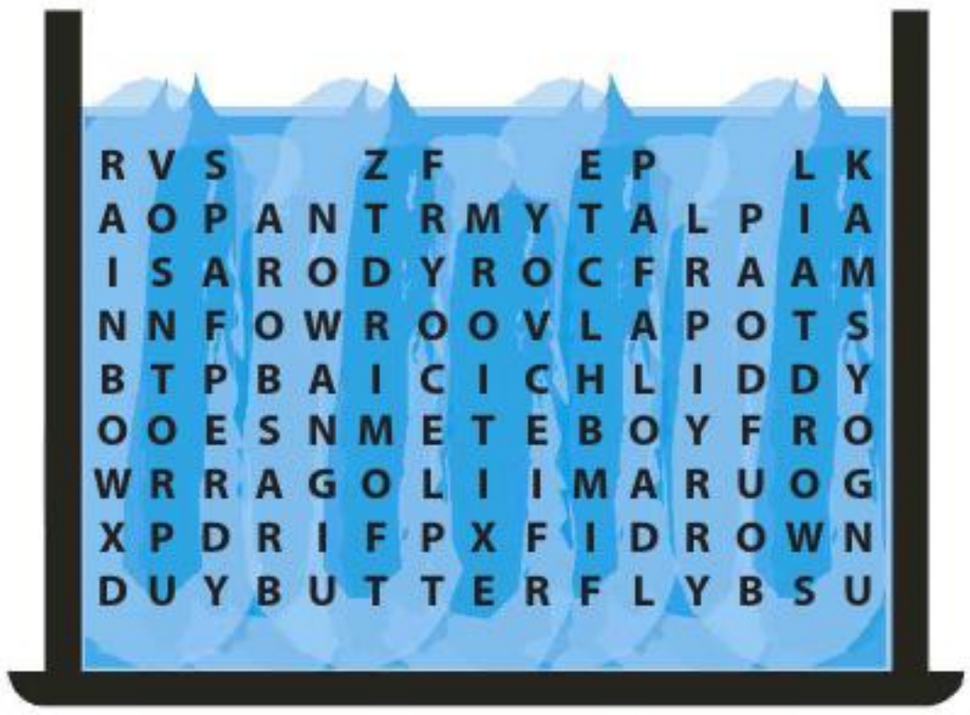
Puzzle page

See if you can solve the puzzles here! You can find all the answers on page 74.

PLENTY OF FISH

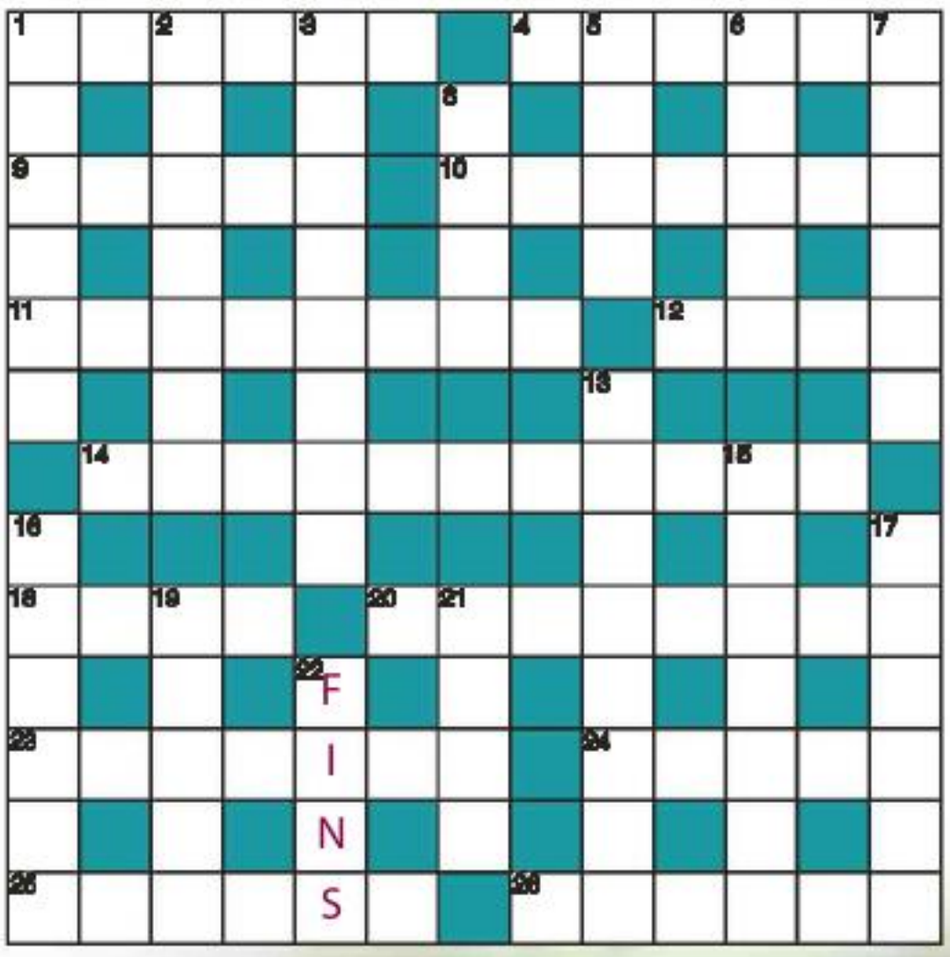
All but one of the aquarium fish listed below have been hidden - up, down, diagonally, back and forth - along straight lines in the grid. Which one is missing?

BARB,
BUTTERFLY,
CORYDORAS,
CICHLID, DANIO,
GOURAMI,
MOLLY,
PLATY, PLECO,
PUFFER,
RAINBOW,
RASBORA,
SWORDTAIL.



PUZZLE IT OUT

Solve the crossword in the usual way except that where a clue is represented by asterisks, you must enter a word that has some connection with the solution already given, which is FINS.



ACROSS

1 Long, thin, narrow wooden boards (6)
4 * * * * * * (6)
9 Criminal case heard in law court (5)
10 Edgy, anxious (7)
11 Soccer (8)
12 Milky white gemstone (4)
14 Pages marking the halfway point in magazines (11)
18 Consumes, swallows (4)
20 Torpedo-shaped oily food fish (8)
23 Blood-sucker, like Dracula (7)
24 One who has a go or makes an effort (5)
25 Dead body (6)
26 * * * * * * (6)

DOWN

1 Postpone, defer (3,3)
2 * * * * * * * (7)
3 Unit of computer memory, 1024 bytes (8)
5 Unit of land measurement (4)
6 Sag heavily (5)
7 Finally, ultimately (6)
8 * * * * (4)
13 Large-crested bird of the parrot order (8)
15 Fouls, soils (7)
16 * * * * * * (6)
17 Flowery (6)
19 Less wild, more domesticated (5)
21 Last word of prayer (4)
22 FINS

ID PARADE

Can you identify this fish?

WHICH FISH IS THIS?

Pictured below are close-ups of the heads of five different fish. Can you identify them?

How to go fishing in your tank

It is not always easy to catch fish in aquarium surroundings. **Don Harper** provides some tips that should hopefully make this task more straightforward, without causing any injury to you or your fish.

Prepare for the worst, and hope for the best! That is not a bad basis from which to start when catching your fish. Turn off and disconnect the power as always, before putting your hands in the water. Carefully lift out any rockwork or other tank décor that could become dislodged and cause injury to the tank occupants, placing these in the bowl or bucket that you have set aside to carry out partial water changes.

Fish will obviously try to avoid being caught, and it is possible to cause a great deal of disruption in the tank when attempting to catch them. The first thing that you will need to have, therefore, is a net of suitable dimensions, since these are produced in various sizes.

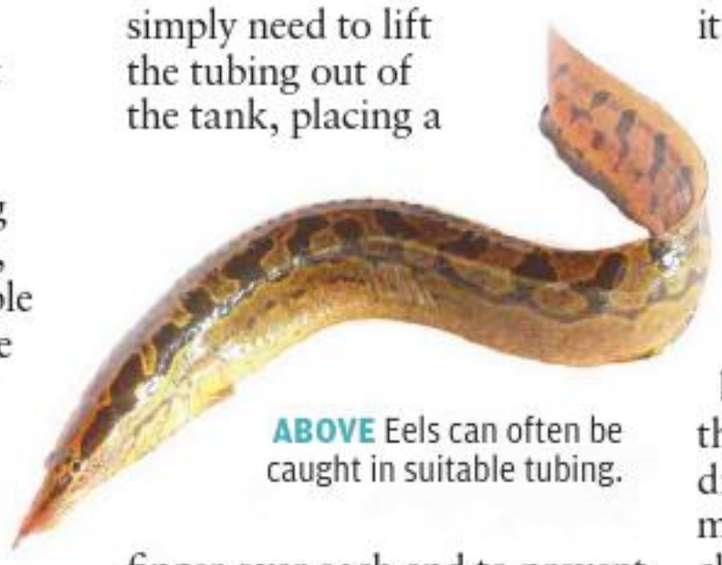
A large net may sound a good idea, but it will be nowhere near as manoeuvrable within the tank as a small net. You need agility to match that of the fish, whereas a large net is simply likely to keep getting snagged, and may uproot plants as well. So select a net that will allow you to scoop the fish individually into it – in most cases, a 10cm (4in) net will be adequate.

Consider your fish

The type of fish that you are trying to catch will influence your technique as well. In some cases, a net may not be necessary, and it could even be counterproductive, particularly in the case of certain fish like the spiny eel, with its snake-like shape. If you try to catch this fish with a net in the aquarium, you are likely to find that it may chose to burrow into the substrate and simply disappears.

A much better method in this case will require stealth and a certain degree of patience. Cut a suitable length of clean rubber hosing and place this within an accessible position within the aquarium.

Before long, the eel will start to investigate this new retreat, venturing inside the tube. You will then simply need to lift the tubing out of the tank, placing a finger over each end to prevent the eel from slipping out. You can then transfer it *in situ* to its new environment.



ABOVE Eels can often be caught in suitable tubing.

Bagged!

Tall fish such as angelfish require a different strategy to catch them. If you are planning to net one of these fish, then you need to approach with the net held on its side as far as possible, to give the best opportunity of catching it.

Another technique is to place a clean, clear plastic bag of suitable size in the tank, allowing it to fill up here. The net in this case can simply be used to steer the fish into the bag, which can then be lifted out of the water.

Should you be intending to move the fish any distance though, rather than just transferring it elsewhere in the home, you will need to empty a large volume of water out of the bag carefully, so it can be replaced with air.

The ambush method

When it comes to dealing with smaller, faster swimming fish such as tetras, they can often be caught most easily by effectively ambushing them. This will be far less disruptive (and probably more successful) than chasing them around the aquarium with a net.

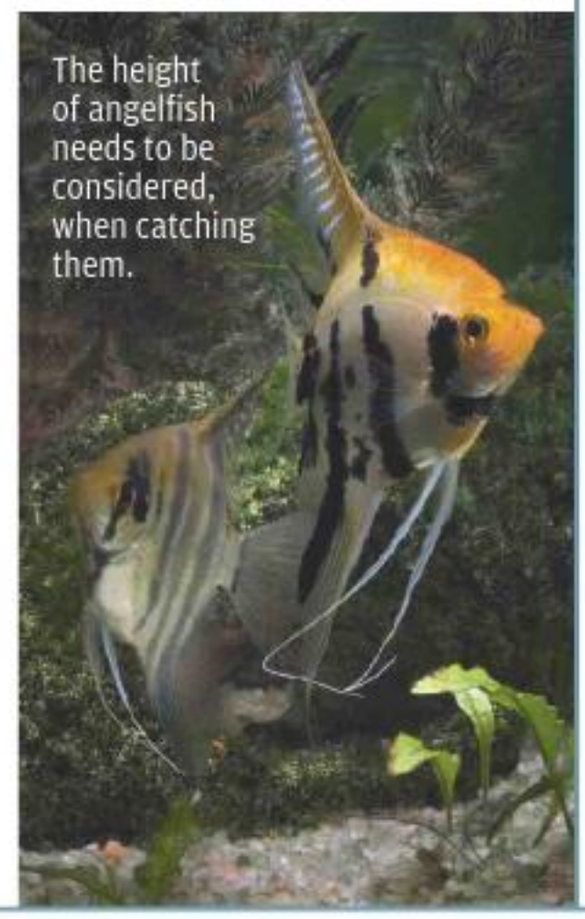
Place the net in the tank, in the relatively open area at the front, so that you can see what you are doing, and lower here into the depths. You can then either drop a little food on to the surface to attract the fish up to feed, or try to steer them to this area of the tank with a piece of cane or a similar object.

Once they are above the net, simply scoop them up from beneath. This is much more likely to be effective partly because they will not have been disturbed, and also, because there will be less drag on the net itself, meaning that you can move more quickly.

And finally...

Do be sure to place your other hand over the net as it comes out of the water, in case any fish then try to leap out. It is not necessarily a question of size – some small fish can jump surprisingly well.

Take particular care when transferring fish with any spines on their bodies out of a net. They can easily become caught up. Once the fish is back in water again though, it should soon be able to wriggle free again.



The height of angelfish needs to be considered, when catching them.

Sailfin molly.
PHOTO COURTESY HRISTO HRISTOV.

Magnificent mollies

Back in the 1970s, things tended to be black and white for a period, and fish keeping was not immune from this style. **David Alderton** reports on a group of fish that have tended to fade from the scene since then.

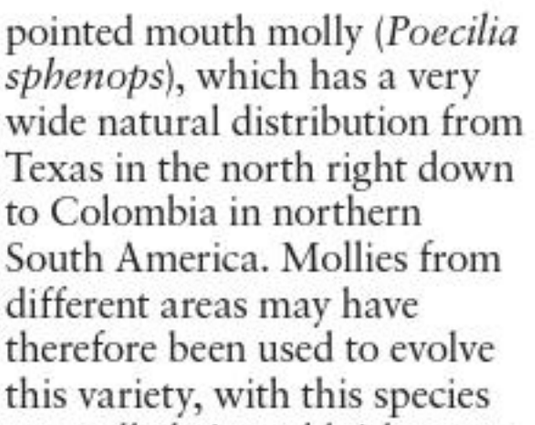
If you visited any aquatic outlet at that time, you were virtually guaranteed to find black mollies in stock. They were frequently displayed in tanks that had a white gravel substrate, and this tended to emphasise their striking matt black appearance.

One of the interesting things about these fish is that they do not exist in the wild, and never have …. Instead, they were specially bred for the aquarium trade, being created during the 1930s. Their origins have been rather shrouded in mystery, probably for commercial reasons at the outset.

Trying to piece the story together

What is known is that a fish breeder called Crencenty used a variety of different species of molly, working mainly with naturally-occurring melanistic (black) forms of the pointed mouth molly (*Poecilia sphenops*), which has a very wide natural distribution from Texas in the north right down to Colombia in northern South America. Mollies from different areas may have therefore been used to evolve this variety, with this species normally being a bluish-green shade, although they are quite variable in appearance.

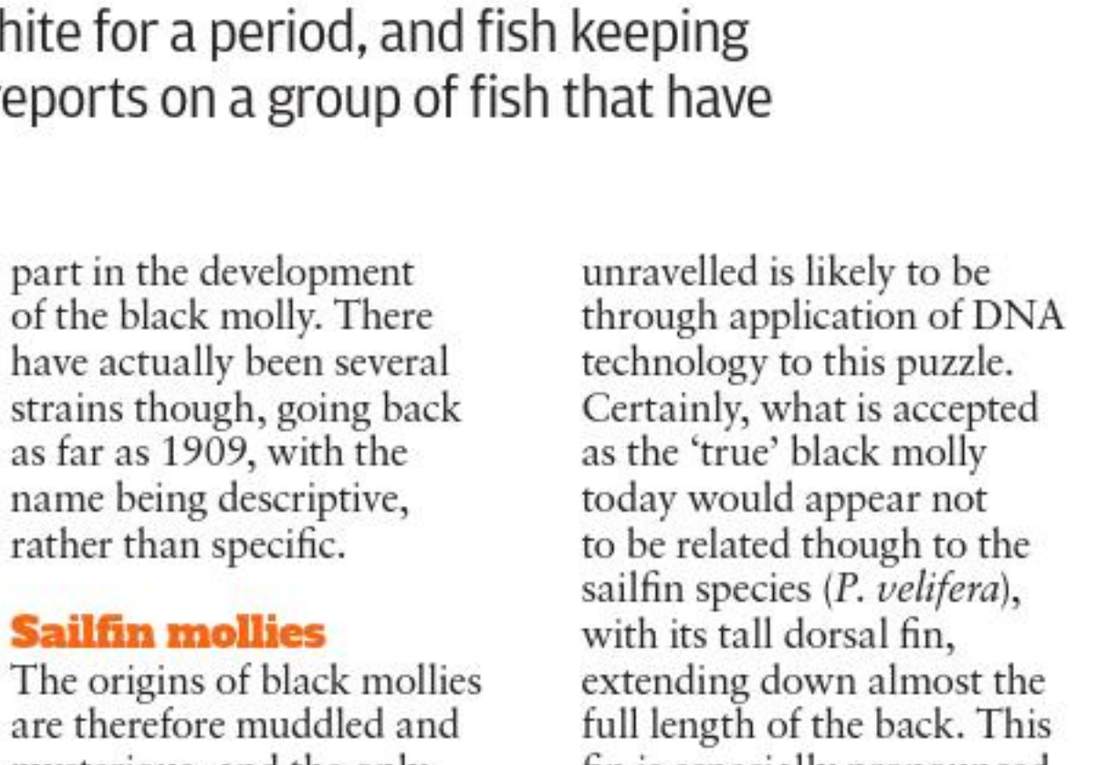
It seems likely the Mexican molly (*P. mexicana*), and particularly the darker coloured form known as Limsantour's molly (*P. m. limantouri*) also played a part in the development of the black molly. There have actually been several strains though, going back as far as 1909, with the name being descriptive, rather than specific.



The wild-type, short-finned molly (*P. sphenops*).
PHOTO COURTESY HUGO TORRES.

Sailfin mollies

The origins of black mollies are therefore muddled and mysterious, and the only way that the truth will be unravelled is likely to be through application of DNA technology to this puzzle. Certainly, what is accepted as the 'true' black molly today would appear not to be related though to the sailfin species (*P. velifera*), with its tall dorsal fin, extending down almost the full length of the back. This fin is especially pronounced in male mollies in this case,



A striking marmalade or orange sailfin molly.

LEFT Dalmatian molly.

being used for courtship.

The colouration of sailfin mollies is very variable, and has become considerably brighter than that of their wild relatives. They also tend to be seen more commonly than in the past, probably at the expense of their black cousin.

Loss of popularity

So what happened that led to the black molly itself falling out of favour? Was it simply changing tastes? Perhaps in part – this was a time when the colourful Afican Rift Valley cichlids started to become available, and they thrived under similar hard, alkaline water conditions, just like mollies.

In all honesty, though, there was probably another, more significant reason. Black mollies developed a reputation for being somewhat delicate. They appeared to be particularly susceptible to the parasitic illness known as white spot or ick/ich (derived from the scientific group name of the parasite, which is *Ichthyophthirius*).

Ich is not unique to black mollies, but it certainly is very conspicuous, when it infects their bodies. The tiny white pin-pricks on the surface of the body and fins tend to stand out very clearly.

In one respect, this is helpful, because it is relatively easy to detect when there is a problem of this type affecting the fish, and gives the opportunity to take rapid action to kill off the parasites. On the other hand, it is an expensive and problematic illness that can spread very easily in an aquarium.

Mollies today

The division nowadays tends to be based around sailfin mollies and various forms of what are often described as Mexican mollies, including the black mollies, that can be distinguished by the short and rounded rather than elongated dorsal fin on the back.

Other fin types now exist though, notably so-called lyre-tailed individuals that are easily identifiable, thanks to the appearance of their caudal fin. The rays forming the upper and lower parts are longer than those in the centre.

Changes in body shade, reflected by a deeper, more compact profile and rounded underparts are evident in the case of the so-called balloon mollies, although such fish do remain rather controversial in the hobby. They may encounter difficulties in maintain their balance in the water, and certainly cannot swim as fast as mollies with the typical body shape, partly because their appearance is less streamlined.

Balloon mollies can therefore be at a disadvantage when seeking food in the company of their more athletic cousins. They are also more susceptible to swim bladder problems, because of the change in their profile, which impacts on this organ.

Sailfins

Sailfin mollies make impressive aquarium occupants, because of their size, which can be virtually double that of a black molly, as they can grow to 18cm (7in) overall. But the dorsal fin of these fish varies in height between individuals, as a result of crossbreeding down the years, not just with black mollies but also with the other sailfin form (*P. latipinna*), with its shorter dorsal fin.

The range of colours in the case of the sailfin is impressive too. There are spotted varieties, notably the form often described as the Dalmatian, which is named after the popular breed of dog. It has randomly distributed black spots present over a

CONTINUES ON THE NEXT PAGE »

Different characteristics can be combined in a single individual. This is a balloon sailfin lyretail molly.

silvery-white background.

In cases where the black spots have coalesced into blotches, these mollies are described as marbled. This is in contrast to the regular spotted patterning of the so-called green molly, which, in spite of its name, has just a pale greenish hue over its body, with the spots extending in neat lines down the sides of the body.

There are some brightly-coloured sailfin mollies now in existence as well, such as the orange or marmalade variety. Then there is a brilliant golden yellow form as well. In this case, it may not be pure yellow, but will have black areas too, which may be confined predominantly to the fins. This is characteristic of the starburst molly, whose appearance will be heightened further by having a metallic body.

Strange habits

It is interesting that even in the wild, hybridisation occurs naturally where different populations of molly come into contact. This phenomenon has given rise to one of the most unusual fish known to exist. This is the Amazon molly (*P. formosa*), which is considered to be a naturally occurring hybrid between the sailfin and the Pacific Mexican molly (*P. butleri*), which may have been involved in the ancestry of the black molly.

The name of these fish does not stem from the mighty South American river, but instead, it comes from the fabled tribe of women warriors that were said to exist on that continent. This name was chosen because hybridisation has led to what is now comprised essentially of a female-only species. Studies suggest that on average, less than one in 10,000 young are biologically male, and those are born are almost always sterile.

As a result, the Amazon molly ranks as the first-ever unisexual vertebrate to be recognised. Females produce offspring that are biological clones of themselves, containing the same genetic material. But they have not diverged completely to live in a society without males.

These female mollies still need to mate in order to reproduce, so they have develop a bizarre behaviour. They seek to seduce males of other molly species occurring in the same waters as themselves, and

A golden lyretail molly.
PHOTO COURTESY HRISTO HRISTOV.

BELOW Black colouration may be confined to the fins in sailfin mollies.

Silver sailfin molly.
PHOTO © MAX GIBBS AT THE GOLDFISH BOWL.

"...mollies, appear to benefit from being kept in water that has been made slightly brackish, by the addition of some aquarium salt"

A pair of black mollies, with the size and fin differences between the sexes being clearly apparent.
PHOTO COURTESY HRISTO HRISTOV.

become accepted by them.

It is now clear that while the act of mating triggers the development of the eggs, the sperm does not actually fertilise them. Research has also revealed that the eggs are comprised exclusively of the female's genetic material, and not just half, as would be expected when mating normally occurs.

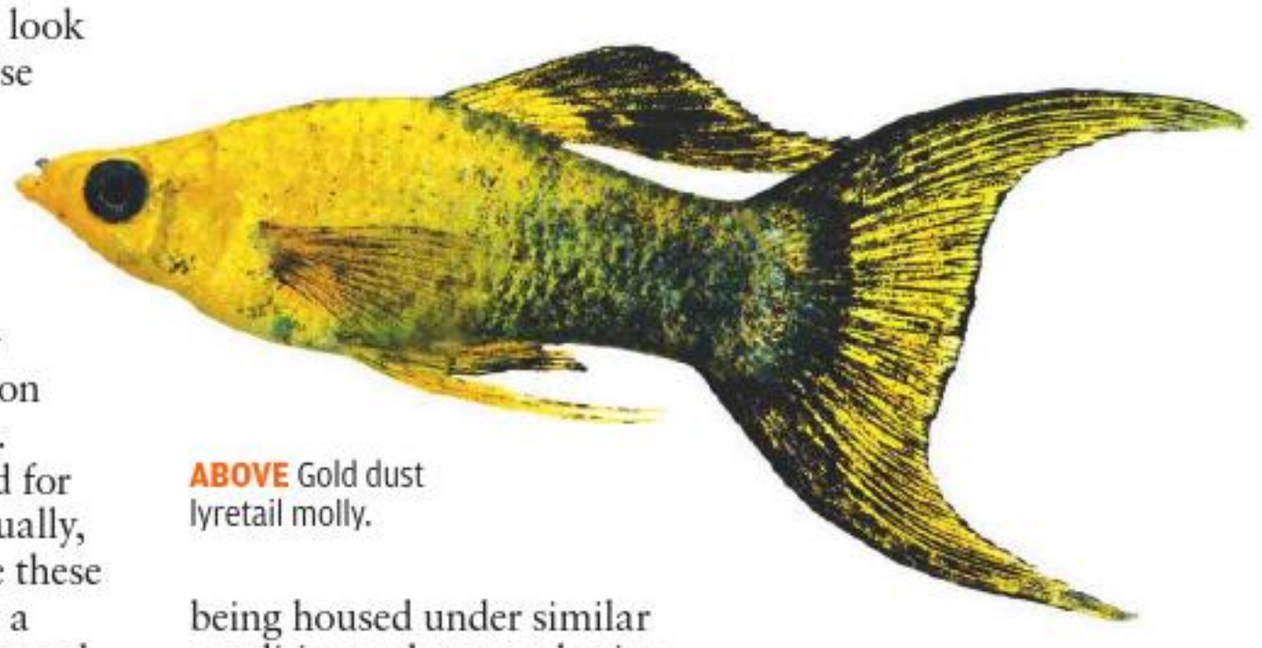
Brackish water conditions

The water requirements of mollies mean that they are best-kept in a species-only set up, or alongside platies (*Xiphophorus maculatus*). An aquarium featuring black mollies

and orange platies can look very striking. Both these group of livebearers, and particularly mollies, generally benefit from being kept in water that has been made slightly brackish, by the addition of some aquarium salt.

This is normally sold for marine set-ups, but equally, it can be used to create these conditions. It is simply a matter of using less salt and preparing a weaker solution, in accordance with the instructions on the packet.

It is worth checking as to whether the fish are being housed under similar conditions when purchasing them though, as you may need to acclimatise them gradually to brackish water conditions. Start off with a more dilute solution to avoid stressing them unduly at a time when they will be more vulnerable to illness. If they are unhappy in their surroundings, they may react by so-called 'shimmying', which entails rocking their body from side-to-side.



ABOVE Gold dust lyretail molly.

Health concerns

Brackish water conditions will afford these fish some protection against fungal infections, but you will still need to be alert to the risk of ich, to which they are so susceptible. Always spend a few minutes observing all the fish for sale in the tank, for any signs of this illness therefore. It may not be easy to spot though, depending on the stage in the lifecycle, and because of the more varied colouration of sailfin mollies, compared with their black relative.

Tiny white dots over the body and fins are the most evident indicator though, being highlighted by the colouration of strains of the black molly. If you spot signs of this illness, or suspect its presence, do no

LEFT Balloon speckled sailfin molly.
PHOTO © MAX GIBBS AT THE GOLDFISH BOWL.

CONTINUES ON THE NEXT PAGE »

TAKE CARE!

If you have more than one aquarium, and are faced with an outbreak of white spot, be sure not to use the net (or other equipment) that will have been in the tank water of the infected fish, as this will transmit the disease readily when dipped in the water of another of your aquariums.

Orange and black sailfin molly.
PHOTO © MAX GIBBS AT THE GOLDFISH BOWL.

"an epidemic can stem from just a single infected individual, triggered by the remarkable reproductive rate of these microscopic parasites"

buy any of the fish, and look elsewhere. This is because an epidemic can stem from just a single infected individual, triggered by the remarkable reproductive rate of these microscopic parasites.

You can buy a seemingly healthy fish, but if you take it home in a bag containing water from the tank where these parasites were present, then it will not be long before your healthy fish are likely to be affected too. The single-celled protozoa responsible for this infection bore into the skin of the molly and start multiplying, giving rise to the distinctive white spots that characterise this infection.

These swellings then rupture, and each can release up to 1000 tomites, which are the free-living stage in the lifecycle of this parasite. Obviously, within the confines of the aquarium, the numbers of tomites will build up very rapidly, and they will have little difficulty infecting other previously healthy fish here. It is this overwhelming increase in numbers coupled with its rapid lifecycle that makes ich such a potentially deadly and easily spread illness.

Control

The areas on the body which developed white spots are then at risk of becoming infected by opportunistic fungi or bacteria that are also present in the water, with the fish's defences breached. Worse still is the fact that if uncontrolled, wave after wave of tomites will attack mollies in an aquarium, progressively weakening them so they die, particularly as their gills become damaged.

If you are unfortunate enough to face an outbreak of white spot, early treatment using a proprietary remedy available from an aquatic outlet is essential, to have any hope of controlling the disease. It is well-worth turning up the thermostat slightly as well.

Mollies will typically thrive at temperatures between 23-28°C (73-28°F). By adjusting the temperature to the upper end of this range, you will be shortening the life of the tomites. This will then give them less time to find and latch on to a host before they die. In the wild of course, *Ichthyophthirius* has to produce so many tomites, in the hope that just a small percentage will live long enough to find other fish to infect. In the aquarium though, there is a ready supply of victims.

Yet there is another potential advantage to turning up the water temperature in the aquarium.

Black and gold sailfin lyretail molly.
PHOTO © MAX GIBBS AT THE GOLDFISH BOWL.


Males may chase each other.


A female black molly.
PHOTO COURTESY HRISTO HRISTOV.

As the immune system of fish functions slightly better at higher temperatures, this should help their body defences to combat secondary infections in particular, giving a chance for their injuries to heal.

Stocking and pairing

When buying mollies, it is usually recommended to obtain several males, so that they can compete amongst themselves for the attention of females. Do not obtain just two, as this will inevitably lead to bullying of the weaker individual by its more dominant companion.

"it is usually recommended to obtain several males, so that they can compete amongst themselves for the attention of females"

There is no difficulty distinguished the sexes in the case of these fish, because females are substantially bigger. If you look on the underside of the body, there is also a key difference in the structure of the fins here, between the sexes.

In males, you will be able to spot the modified anal fin, which has formed the tube-like structure known as the gonopodium, which the male uses when mating with the female. As livebearers, females retain the eggs in their body until they are ready to hatch, and the young mollies are born at intervals of about six weeks.

Each brood may be comprised of 40 up to as many as 300 offspring. Under suitable conditions, mollies are prolific fish, producing broods regularly, but certainly without plenty of cover in the aquarium, the young run the risk of being eaten by the adults.

Mollies tend to be less predatory in terms of their feeding habits than most other livebearers such as guppies though. They have a reputation for browsing on algae in the tank, and certainly, this plant matter can make a valuable addition to their diet.

However, they are still omnivorous in their feeding habits, rather than strictly herbivorous. With their upturned mouths, mollies instinctively feed at or near the surface. They are very easy to look after in this respect, as they will readily eat a variety of prepared foods and small live foods too.

The key to keeping mollies successfully is simply to start out with good stock. They can live for 2-3 years on average. Take great care to ensure as far as possible that your initial stock is healthy and things should then progress on a trouble-free basis. Just remember - if in doubt, look elsewhere!


Marbled molly.
PHOTO © MAX GIBBS AT THE GOLDFISH BOWL.

Next issue

MARCH/ APRIL ISSUE ON SALE FRIDAY, 14TH FEBRUARY

Malawi cichlids

Bill Lowe explores the fish to be found within this fascinating African lake, and explains how to keep and breed them successfully in the home aquarium.

The Fish Doctor

One of the major health problems that can strike aquarium fish is fungus. Discover why this is the case, and what can be done, both to treat this condition and also, how to keep your fish safe from infections of this type in the first place.

Pretty platies

These livebearers can make a great introduction to the hobby, and they are now being bred in a wide range of colours. Discover more about them, including their remarkable biology and care.

Puzzle page

WHICH FISH IS THIS?

Pictured below are close-ups of the heads of five different fish. Can you identify them?

1 Discus (*Symphysodon sp.*) 2. Piranha (*Serrasalmus sp.*) 3.Firemouth cichlid (*Thorichthys meeki*) 4. Red-tailed catfish (*Phractocephalus hemioliopterus*) 5. Oscar (*Astronotus ocellatus*)

PUZZLE IT OUT SOLUTION

Across: 1 Planks, 4 Caudal, 9 Trial, 10 Nervous, 11 Football, 12 Opal, 14 Centrefolds, 18 Eats, 20 Mackerel, 23 Vampire, 24 Trier, 25 Corpse, 26 Dorsal.
Down: 1 Put off, 2 Adipose, 3 Kilobyte, 5 Acre, 6 Droop, 7 Lastly, 8 Anal, 13 Cockatoo, 15 Dirties, 16 Pelvic, 17 Floral, 19 Tamer, 21 Amen, 22 FINS.

ID PARADE ANSWER

Striped zebra or Burmese loach (*Botia histrionica*)

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KELSEY PUBLISHING GROUP
Cudham Tithe Barn, Berry's Hill, Cudham, Kent TN16 3AG
Telephone: + 44 (0)1959 541444
Fax: +44 (0)1959 541400

EDITORIAL
Editor: David Alderton
Email: pf.ed@kelsey.co.uk
Art Editor: Mark Baker
Publisher: Stephen Curtis

ADVERTISING
Advertisement Manager: David Lerpiniere
Telephone: 01959 543507
Email: pf.adsales@kelsey.co.uk

Advertising Sales Executive: Kara Goodwin
Telephone: 01959 543586
Email: pf.adsales@kelsey.co.uk

Advertising Production manager: Karen Ayress
Telephone: 01959 543541
Email: adprod@kelsey.co.uk

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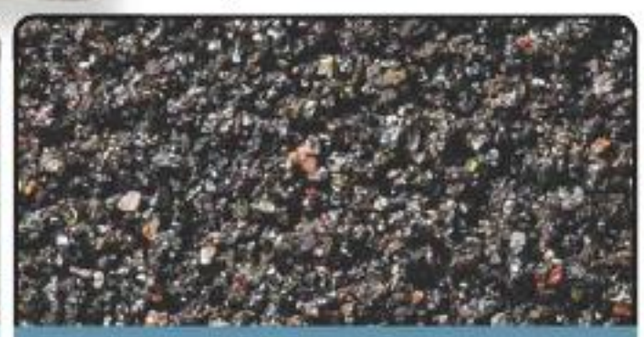

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