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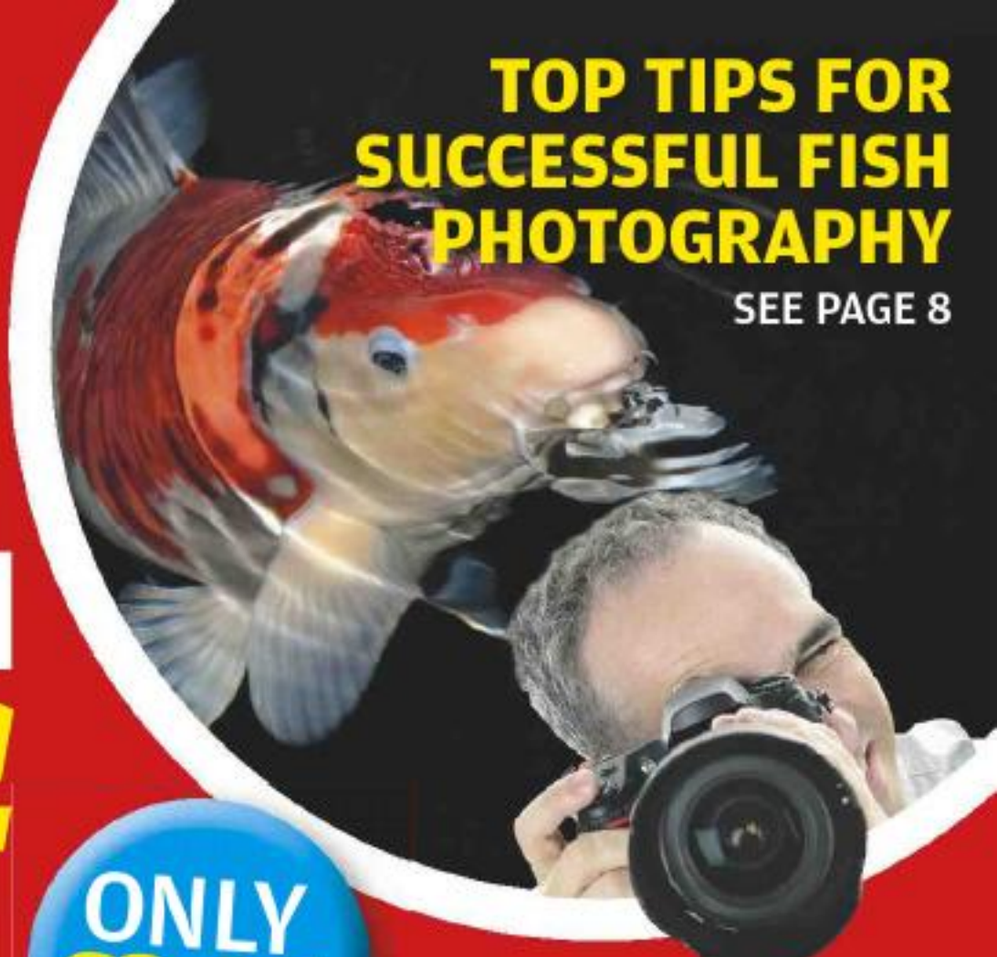

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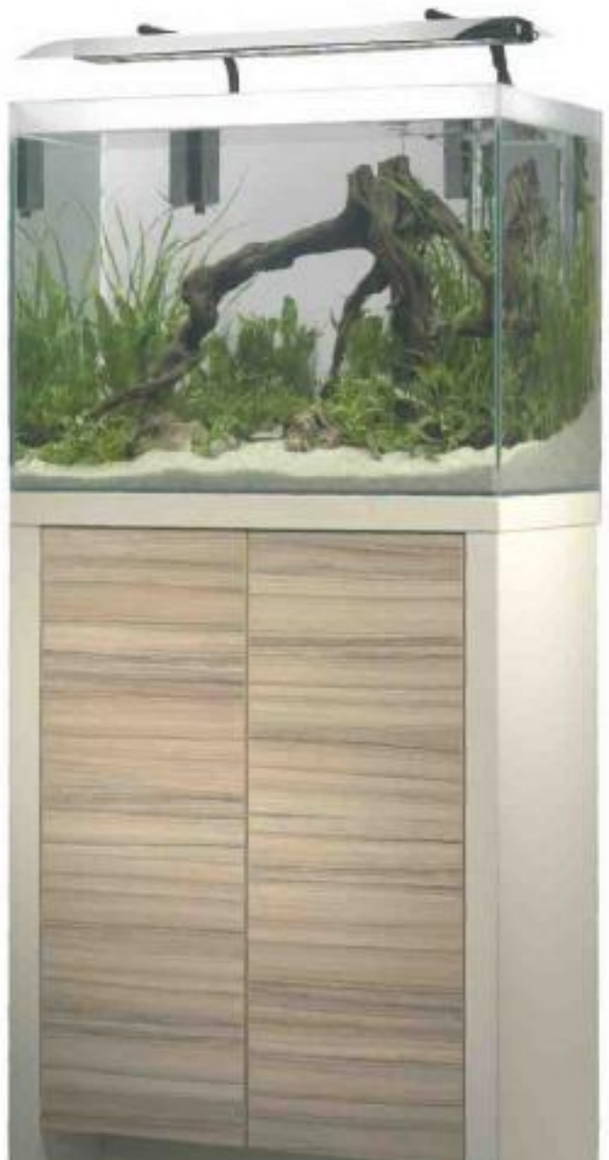

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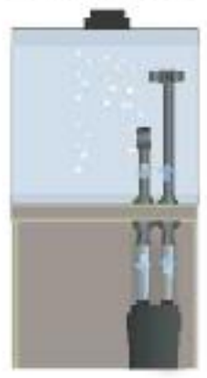

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hello

Many thanks to everyone who been in touch following our first issue, with your comments, questions and suggestions. They're all very welcome, and please keep them coming!

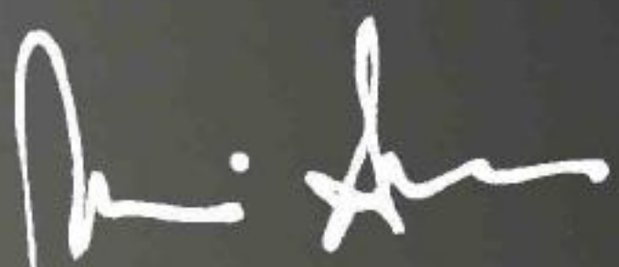
We've also enjoyed seeing the photos of your fish and set-ups that you've sent. In response to several requests, there's an article in this issue on how to take good photos of your fish, without letting the aquarium glass spoil the effect – even when using a camera phone.

If you're looking for a great weekend away soon with a fishy theme, don't miss the Festival of Fishkeeping, which is being organised by the Federation of British Aquatic Societies. This event is taking place over the weekend of September 7th-8th, at Hounslow in Middlesex, and offers the biggest display of hobbyist fish to be seen in the UK. There will be various fish keeping demonstrations, with experienced advice being freely available too. Breeders will also be offering some of their fish for sale.

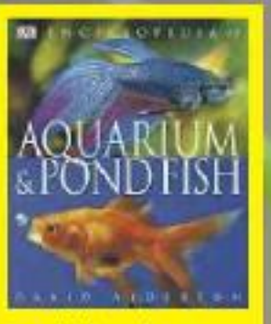
There are both camping areas and caravan pitches on-site, not to mention the Sunbury Travelodge close-by, so a visit need not cost a fortune either. You can find full details on our news pages.

The festival showcases many of the country's very best fish, ranging from discus to specialist goldfish, and by way of introduction, to explain more about how shows operate and the way that fish are judged at such events, we've got an interview with a leading judge in this issue.

Finally, don't miss out on our great subscription offer. We'll be publishing every two months, and our next issue will be available on October 18th. If there's anything particular that you'd like to read about, just email me, and I'll aim to arrange it.



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



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.

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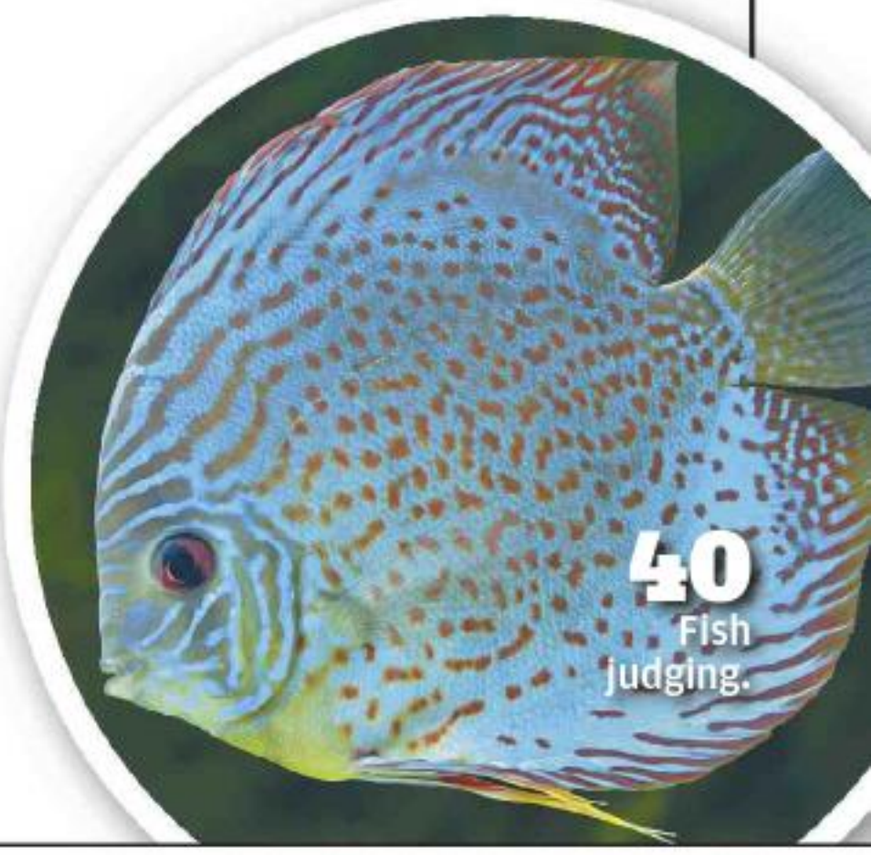

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News & views

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

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

New catfish found

Scientists have discovered a tiny new species of catfish in the waters of Rio Paraíba do Sul basin, in south-eastern Brazil. The new species, now called *Pareiorhina hyptiorhachis*, belongs to a genus of armoured catfishes native to South America and found only in Brazil. The new species is distinguished from other related catfish by the presence of a conspicuous ridge on its body behind the dorsal fin. *Pareiorhina hyptiorhachis* is only about 3-3.5cm (1.1-1.4in) in length, making it one of the smallest representatives of the catfish order. Some of the smallest members of the families Aspredinidae and Trichomycteridae are even tinier though, measuring only 1cm (0.4in) when mature. At the other end of the scale is the gigantic wels catfish, which can reach more than 2.5 metres (8.2 ft) in length and sometimes weighs more than 100 kilograms (220 lb).

The newly discovered catfish now known to science as Pareiorhina hyptiorhachis. *PHOTOGRAPH COURTESY GABRIEL DE SOUZA DA COSTA E SILVA; CC-BY 3.0.*

FURTHER INFORMATION

Silva GSC, Roxo FF, Oliveira C (2013) *Pareiorhina hyptiorhachis*, a new catfish species from Rio Paraíba do Sul basin, southeastern Brazil (Siluriformes, Loricariidae). *ZooKeys* 315: 65. doi: 10.3897/zookeys.315.5307

Festival of Fishkeeping

A fantastic event organised by the Federation of British Aquatic Societies, covering all aspects of fish keeping, will be taking place in Middlesex over the weekend of September 7th and 8th. There is plenty to interest the entire family, as the venue is home to a variety of farm animals and other creatures, with bouncy castles, animal rides and a children's petting zoo among the available attractions.

You can enjoy the largest display of hobbyist fish on show in the country, including the leading examples of their type. The Goldfish Society of Great Britain Show for example is staging a show here over both days, and there is also a killifish show on Saturday, along with a catfish display.

The Festival Aquarist Society Master Open Show plus the Diamond Class event are scheduled for the Sunday. A number of displays and talks will be provided for visitors, with fish keeping advice being freely available.

Entertainment, food and refreshments are offered on-site on the Saturday evening, from 7-11pm. Admission to this part of the event is £5, and includes both a raffle ticket and a complimentary snack.

If you want to stay, then you may still be able to book into the nearby Sunbury Travelodge, Hanworth Road, Sunbury on Thames, TW16 5DA. It is located right next to J1 of the M3. The best current prices for rooms and details about availability can be found online at the Travelodge website – www.travelodge.co.uk with parking being extra. There is return coach travel to and from the farm available from the Travelodge for £5 per person.

Information at a glance

When: 10am-5pm, Sept 7th and 8th.
Where: Hounslow Urban Farm, Faggs Road, Feltham, Middlesex, TW14 OLZ.
Admission costs: £6 adult, £4.50 child (over 2 years old) with family tickets being £19 (two adults and 1-2 children). The cost for students and pensioners is £5.25. These prices are for full day tickets, allowing you to come in and out all day. Children under 2 years old are free.
Further information: email Joe Nethersell, the Festival Organiser, on joenethersell@gmail.com or phone 07970 106434.

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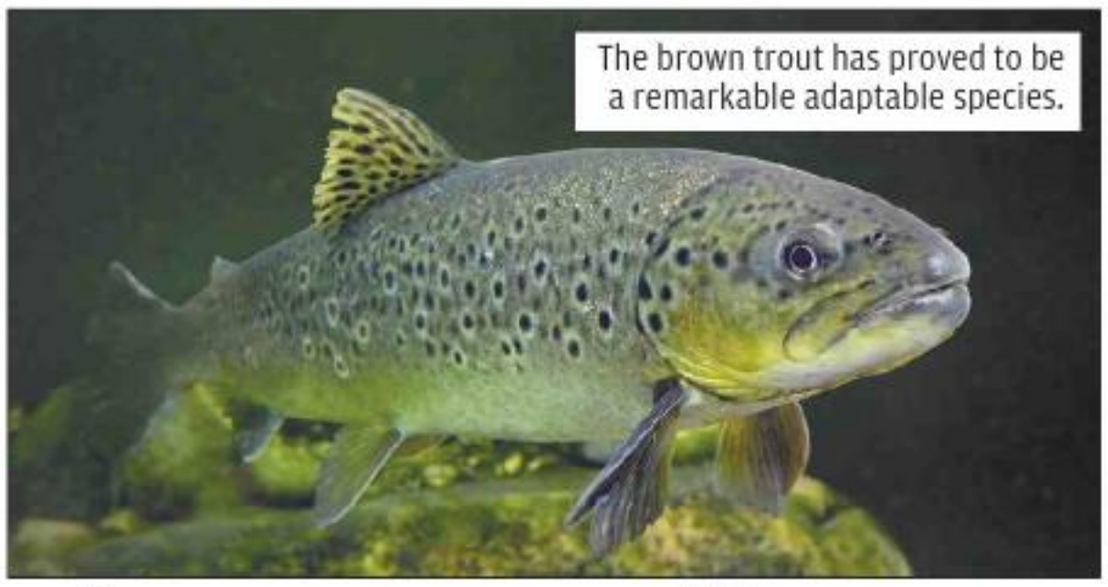

The brown trout has proved to be a remarkable adaptable species.

The extraordinary adaptability of fish

New research from the University of Exeter and King's College London has shown how a population of brown trout are surviving in the contaminated waters of the River Hayle in Cornwall, where metal concentrations are so high they would be lethal to fish from unpolluted sites elsewhere. The researchers compared the trout found there with a population living in a relatively clean stretch of water in the River Teign. The results showed that the accumulation of metals in the kidney and liver – where metals are stored and detoxified – was respectively 19 and 34 times higher in the Hayle trout. In the gills, concentrations averaging 63 times higher were present in the trout from the River Hayle, but there were no differences in metal content in the gut. This accumulation of metals in the Hayle fish highlights their extraordinary tolerance of the extreme metal concentrations in their environment.

How they survive

Further study on these trout revealed that a particular gene, controlling a protein called metallothionein that helps to detoxify metals, was highly active. In addition, changes in genes responsible for maintaining the balance of ions in the body and a modest increase in anti-oxidants was also found, with both these changes helping to offset the toxic effects of the metals in their bodies. Tamsyn Uren Webster, who was one of the researchers involved in the study, explains: "This particular population of brown trout has developed strategies for dealing with the metal pollution in the water and the accumulation metals in their tissues, so as to avoid the lethal damage that such concentrations would normally cause."

Unique survivors?

The county of Cornwall has a long history of mining, and although much of this industry ceased during the 19th and 20th centuries, a number of rivers and estuaries still contain high levels of metals. A detailed understanding of how the Hayle trout population has developed this tolerance to metals could have potential implications for re-stocking rivers and increasing food security in polluted regions of the world.

"The story of the brown trout in the River Hayle is a fascinating one, demonstrating its resilience and its ability to defeat the odds and tolerate the challenges imposed upon them as a result of human activities," added her colleague, Dr Eduarda Santos.

"Many aspects of this story remain untold: we do not know how or when this tolerance has arisen, and, most importantly, we do not know what the future holds for them if they are challenged with further stressors in their environment.

"But we know that such populations need careful management; if the Hayle brown trout, with their unique physiology, were to be lost, it is possible that this river may never be home to brown trout again. Therefore, understanding the relationship of fish with their environment is a crucial requirement to effectively manage and protect our aquatic ecosystems."

You can read the full study online here. Please visit: http://pubs.acs.org/doi/abs/10.1021/es401380p

New public aquarium in the north-west

A new Sea Life Centre has just opened in Manchester, bringing the total number of these centres around the country to 13 - plus the Cornish Seal Sanctuary.

All provide a window onto the seabed, and provide astonishing close-up encounters with thousands of sea creatures, consisting of well over 100 different species. Everything from humble shrimps and starfish to seahorses, stingrays and sharks are housed in hi-tech, spacious displays. Most centres have a giant ocean tank at their core, with a spectacular walkthrough underwater tunnel offering strolls on the seabed, surrounded by tropical sharks, colourful shoaling fish and sometimes even giant green sea turtles. Conservation is at the heart of everything these attractions do, whether simply through increasing awareness of threats to species or by raising funds for field projects. They have even managed to raise enough cash to build a sea turtle rescue centre on the Greek island of Zakynthos. Many of the centres lead visitors on a journey from freshwater displays to coastal exhibits and then onto the deep ocean. Regular feeding sessions, talks and special events offer a deeper insight in the marine world, and every centre refreshes its offering annually with the inclusion of a special feature exhibition. Sea Life Centres are becoming increasingly popular destinations for educational school visits, and their in-house education team is constantly refining its packages for schools to help pupils get maximum learning opportunities - not to mention enjoyment! - from their visits

You can find out about each centre and its own unique features by visiting www.visitsealife.com and then selecting from the menu of different locations.

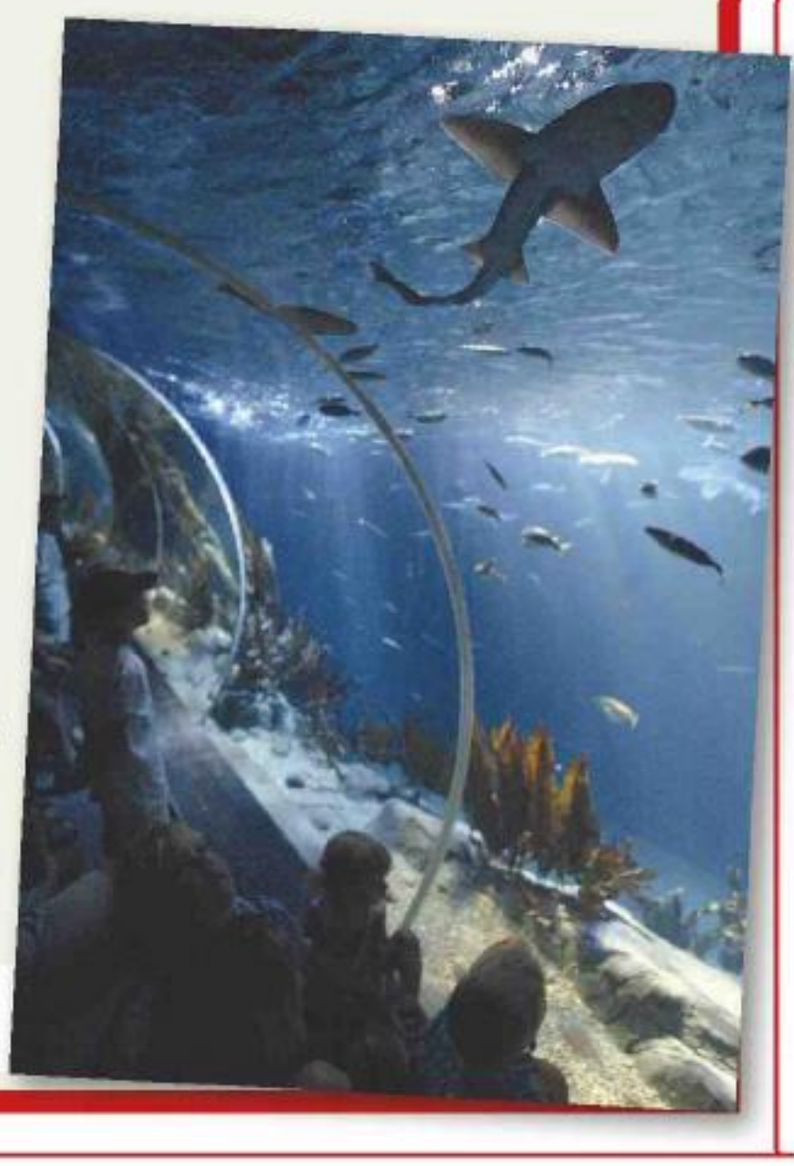


PHOTO COURTESY SEA LIFE CENTRES

How to capture fish

I don't mean catching fish in a net or dangling a worm off a hook though, writes **Adam Hough.** I mean taking great photos of fish that you will want to keep, even on a camera phone.

I have been using cameras for many years now and it's certainly the case that taking pictures of fish can be difficult, needing an element of luck as well, but as long as you follow some simple rules, you should be able to obtain some great pictures.

Environmental difficulties

Being under water is an obvious problem but luckily, your subjects are likely to be in aquariums. At home, make sure that your tank is kept clean, using an algae magnet that allows you to wipe away any traces of these microscopic plants that can colonise the glass as well as other surface in the aquarium.

It will allow you to ensure that the glass is crystal clean, without having to get your hands wet, helping to ensure the photo is therefore pin sharp, with no blurring in the foreground. Algal issues can be more of problem in pubic aquaria though, where you will not be able to clean the glass within the tank, so you will need to choose the area where you take the photograph more carefully,

Always make sure that you clean this area outside of the tank with a soft wipe, and try to remove as much dust as possible. Otherwise, the auto-focus on the camera will invariably pick up on this, rather than your subject.

Deciding what type of image you want to take is vital.

A macro setting will allow you to get in close

ALL PHOTOS COURTESY OF THE AUTHOR

Another point to consider in terms of the tank is the issue of reflection. In a well-lit room, you will pick up parts of the room that will reflect on the aquarium glass. You can try a couple of things to stop this from happening though. Change your angle slightly, move the object or making the room darker can all be helpful ways of overcoming the problem.

Camera choices

The next thing to consider is the camera itself. There are some fantastic pieces of equipment on the market these days but to obtain a nice photo does not have to break the bank. Firstly, get comfortable with your camera and any other equipment such as lenses. Study the user's manual and read up on all the functions that your camera possesses. I will talk about a couple of these functions briefly.

Most if not all digital cameras will come with a flash, but you can turn this off in the 'flash settings' on your camera. If you use a flash when trying to photograph your fish through the glass, you will get a beam of light blocking out the fish on your photo as the glass bounces the flash back. Since tanks can be quite dark, using some additional LED (light-emitting diode) lights above the tank will help.

On some of the higher end cameras such as those in the DSLR (digital single lens reflex) range, you can manually change the ISO settings. The camera's ISO is a reflection of its sensitivity to light. If you have a low ISO, so you will require more light to make an exposure.

Conversely, if you are using a high ISO, then less light will be necessary. There is a small downside to using a high ISO though, as it means the image will be a little grainy. But in reality, this is not usually that noticeable, especially with the recent advances in technology in this area. I try not to exceed an ISO of a thousand, but if the fish you are observing are in an Amazon style set-up with dark water, then this may prove to be necessary.

The macro setting

The symbol is usually the sign for a macro setting on a camera. It is extremely useful when taking pictures of small objects or objects that you want to get close to. This will not make you zoom in more to your subject, but it will focus much closer to your subject, sometimes within centimetres. It is an amazing function, so try it out. Even most phone cameras have this facility today. Another piece of kit that I would recommend for a couple of reasons, although it is not essential, is a tripod. There are a number of different types available today. A tripod will hold your camera steady and this will make the image sharper, as there will be less movement. Also, remember that you are taking photos of fish that are non co-operative, unlike most human subjects, so you could be holding the camera for some time in order to get the ideal shot. A tripod will make this a less tiring experience, and eliminates the risk of shaking through hand fatigue!

A dark environment can pose problems.

Popular Fish Keeping Top tips: On shooting your fish

The focus here is on the female cichlid, rather than her fry

1 Tempting them out

Battling to get your subjects to show themselves? Then try tempting your fish out with their favourite food!

2 Framing your subject

When taking a photograph, you are trying to create a picture. I know this might sound rather obvious, but it is about more than just what is present in front of your eyes. It's about both the subject and the subject's environment. As an example, do you want just the head of the fish in the frame with an attractive contrasting black background, or are you hoping to be able to show a shoal of fish swimming through a stand of aquatic plants? Try to imagine the picture that you are aiming to obtain, in your mind's eye, and then go for it!

3 Camera phones

Why go and buy a camera when the Swiss army knife of today's technology provides you with one? Camera phones are getting better every year, to the extent that some now rival the results that can be obtained with compact point and shoot cameras. Many camera phones now possess exactly the same functions as a dedicated camera of this type, including a flash that can be manually adjusted, a macro mode setting, plus touch screen focusing as well. If you follow the tips in this article therefore, you should be able to get exactly the same results from a camera phone as from a compact point and shoot camera.

Get involved!

Are you a keen photographer? Have you got some great photos of your fish? Why not share them with your fellow readers? Email your favourites, with information about the subjects, to pf.ed@kelsey.co.uk

AT A GLANCE

Great fish keeping advice from the Popular Fish KEEPING team

Find out about bush fish in just 5 minutes

One of the popular misconceptions in the hobby is that all labyrinth fish come from south-east Asia or thereabouts. Whilst certainly tropical, the distribution of the banded climbing perch for example actually ranges from Senegal in western Africa eastward across the continent to the lakes of the Rift Valley. **Jake Ward** explains more.

The ornate climbing perch.

PHOTOS COURTESY PHOTOMAX AT THE GOLDFISH BOWL

Leopard bush fish (*Ctenopoma acutirostre*).

Did you know?

A special labyrinth organ adjoining their gills means that these fish can breathe atmospheric air directly, in common with other labyrinth fish. But in the case of the banded climbing perch though, it can breathe air while moving out of the water, giving this species a distinct advantage in the survival stakes. These fish are actually able to move short distances across land on occasions as a result, using their pectoral fins to drag themselves along. This enables them to colonise new areas, or retreat from where a pool may be drying up, setting off to find a larger body of water.

Sexing in this instance is reasonably straightforward, because the male banded climbing perch (*M. fasciolatum*) has much larger dorsal and anal fins than the female, and is also more colourful. Floating plants should be included in a spawning tank, as the male will often choose to construct his bubble nest among them. He creates this simply by blowing bubbles of saliva for this purpose. Assuming that the fish are mature, being at least 7.5cm (3in) long, then spawning is quite likely to occur at some stage. This has proved to be one of the easier species to breed. The eggs will rise to the water's surface, and are collected by the male, who then transfers them to the nest. There may be as many as 1,000 deposited as the result of a single spawning.

The young will hatch within a day, and will be free-swimming in a further 48 hours. They need to be reared on special fry foods at first. They should grow quickly, and may have reached about 1.3cm (0.5in) just two months after hatching.

The common name of this African group in fishkeeping circles is 'bush fish'. As the American author Bob Goldstein once observed, with great perception (and no little wit), they might be better known as ambush fish, thanks to their natural hunting behaviour.

The genus *Ctenopoma* serves as another name for the unwary when it comes to trying to pronounce it. The 'C' in this case is silent so that the name is pronounced '*t'en-oh-pohma*' as a result.

This description actually means 'combed' and describes the extensions on the rear of the gill cover that are shaped like the teeth of a comb. (In this context, you may come across the word 'ctenoid' referring to a particular type of fish scale; again, this describes similar edging).

The group

As is usual in the world of fishkeeping, some name changes have occurred quite recently - around 1995 in this case. These have resulted in some species being reclassified into the genus *Microtenopoma*, although the logic that all small species fitted into this new category does not always hold true. The reason for the 'micro-' prefix lies in other physical attributes rather than just their overall size.

DID YOU KNOW?

Microctenopoma fasciolatum

Common name: Banded ctenopoma; banded climbing perch.
Origin: Zaire (Congo).
Size: 8.5cm (3.5in).

Species within the *Ctenopoma/Microtenopoma* genera divide into two basic shapes, with one being more cylindrical than the other – this group includes *M. ansorgei*, *M. argentoventer*, *C. multispinis*, *M. nanum* and *C. nigropannosum*. The deeper-bodied species are *C. acutirostre*, *M. congicum*, *M. fasciolatum*, *C. kingsleyae*, *C. ocellatum* and *C. oxyrhynchum*.

With some of these latter bush fish, the dorsal, caudal and anal fins are so near to each other that they often appear to be joined, encircling the rear half of the fish with one complete fin. The outer edges of the fins may well be transparent and this helps to disguise their typical 'fishy' outline and so helps to camouflage the fish in its natural habitat.

Predatory by nature

Speaking of camouflage, most species are of the 'mottled hue' variety, as you can see. This is an extremely practical colouration for hiding amongst aquatic plants, waiting ready to pounce on any passing meal. The exception to this rule is the ornate climbing perch (*M. ansorgei*), whose cylindrical body is covered with alternating vertical stripes of dark brown and orange.

Whilst many of the gouramis are looked upon as gentle, graceful fish (although everyone always overlooks the fierce territorial nature of a nest-guarding dwarf gourami!), the same description does not fit bush fish at all. They are definitely predatory, as one look at their large, sharp-pointed jaws will indicate. They are therefore not suitable for the community aquarium, and so need to be kept apart.

Tank design

Their size ranges from a modest 7cm (2.8in) to a much more menacing 20cm (8in). For fish that like to hide yet have voracious appetites (which fortunately do not extend to the plants), this presents two distinct obligations on the part of the fishkeeper.

Firstly, the aquarium must be tailored to suit the eventual size of the fish – so do your homework before obtaining the species: probably a 60cm (24in) tank is the minimum size required, even for the smaller species, with anything larger being a bonus for the fish.

In all cases, the aquarium must be furnished to provide extensive hideaways, in the form of bushy thickets and caves where these fish can lurk. With the extensive use of plants, the light conditions in the aquarium will subsequently be quite dim, so make sure plants you use are able to thrive under less than brilliant lighting.

Coming from central Africa (well, we'll take an average location between west and east just to be on the safe side!) the water temperature should be maintained on the higher than usual side of things, say around 27-28°C (79-81°F).

Feeding

In addition, a wide and varied diet must be available, and it should include 'meaty' foods in the main. While it is reported that many bush fish will take flake and other dried foods, we all know the risk to water quality caused by uneaten foods.

Live foods may be better than their frozen or freeze-dried versions simply for the reason that they move around a bit, and so will appeal to the 'snatch and grab' instincts of these fish, in comparison with food just laying there.

Water circulation need not be too vigorous but some movement may help to keep otherwise inanimate food on the move. This is a significant feeding trigger for these fish. In the wild, some species may inhabit faster flowing waters, but retreat to slower backwaters when breeding.

Reproductive behaviour

The breeding of bush fish appears to be something of a mystery – extending from the sexing of individual fish right through to how they breed. Not only that, but should you be successful, then you may not be able to repeat the exercise to order! It is very much down to the fish themselves in this case.

There are generally no apparent external sexual differences between the sexes and whilst some have been observed to utilise bubble nests, the fry simply appear without any visible preamble in other cases. This has led some people to wonder as to whether mouth brooding is employed?

Should you see fry in the tank, it would be prudent to remove the adults and leave the young in this large tank where they can grow without fear of being preyed upon. Bear in mind, though, that they might have a job finding the small food that they initially require in such a large space. Leaving a dim, low wattage light on 24 hours a day may help out in this respect.

A good introduction

The banded climbing perch is probably the most widely available bush fish. Like other members of the group, this species is relatively dark in colour, varying from shades of brown to bluish-grey, with blue being especially apparent in the fins. The scales are very pronounced.

Other species

Ctenopoma acutirostre
Common name: sharp-nosed ctenopoma; leopard bush fish; spotted ctenopoma.
Origin: Zaire (Congo).
Size: 15cm (6in).

Ctenopoma kingsleyae
Common name: tail-spot ctenopoma.
Origin: Senegal.
Size: 20cm (8in).

Ctenopoma ocellatum
Common name: eye-spot ctenopoma.
Origin: Zaire (Congo).
Size: 14cm (5.5in).

Ctenopoma oxyrhynchum
Common name: mottled ctenopoma.
Origin: Zaire (Congo).
Size: 11cm (4.3in).

Living in harmony

For many people, part of their dream of setting up an aquarium is to establish a mixed collection of fish, which will live together without any problems. Unfortunately, the reality can sometimes prove very different. Here experienced fish keeper **Don Harper** reveals what can make the difference between success and failure.

It might appear simple, setting up a community aquarium, but there are a number of diverse factors that you need to bear in mind, right from the outset, because unfortunately, it is not just as simple as choosing the fish! The first place to start is with the size of your tank.

Bear in mind that if you exceed the recommended stocking density within the aquarium, the likelihood is that you will encounter problems. You should therefore choose the largest tank that you can afford and accommodate in the space available.

Surface area

It is usually recommended to allow about 75cm^2 (12in^2) for each 2.5cm (1in) of body length of the fish, minus the length of the caudal (tail) fin. This is important because it is at the surface of the water where gaseous exchange takes place.

You can work out the total surface area simply by multiplying the length and width of the tank together. A tank that is 91cm (36in) long and 30cm (12in) wide therefore has a total surface area of 2787cm^2 (432in^2).

Water volume

The other key consideration is the water volume in the tank. You will need to work out the volume of your tank in litres, if it is not marked on the label – assuming that you are buying a new tank.

This is very simple to do these days, on the web. All you need are its dimensions in centimetres – length x width x depth – and then you need to log on to the website of The International Federation of Online Clubs and Aquatic Societies (IFOCAS).

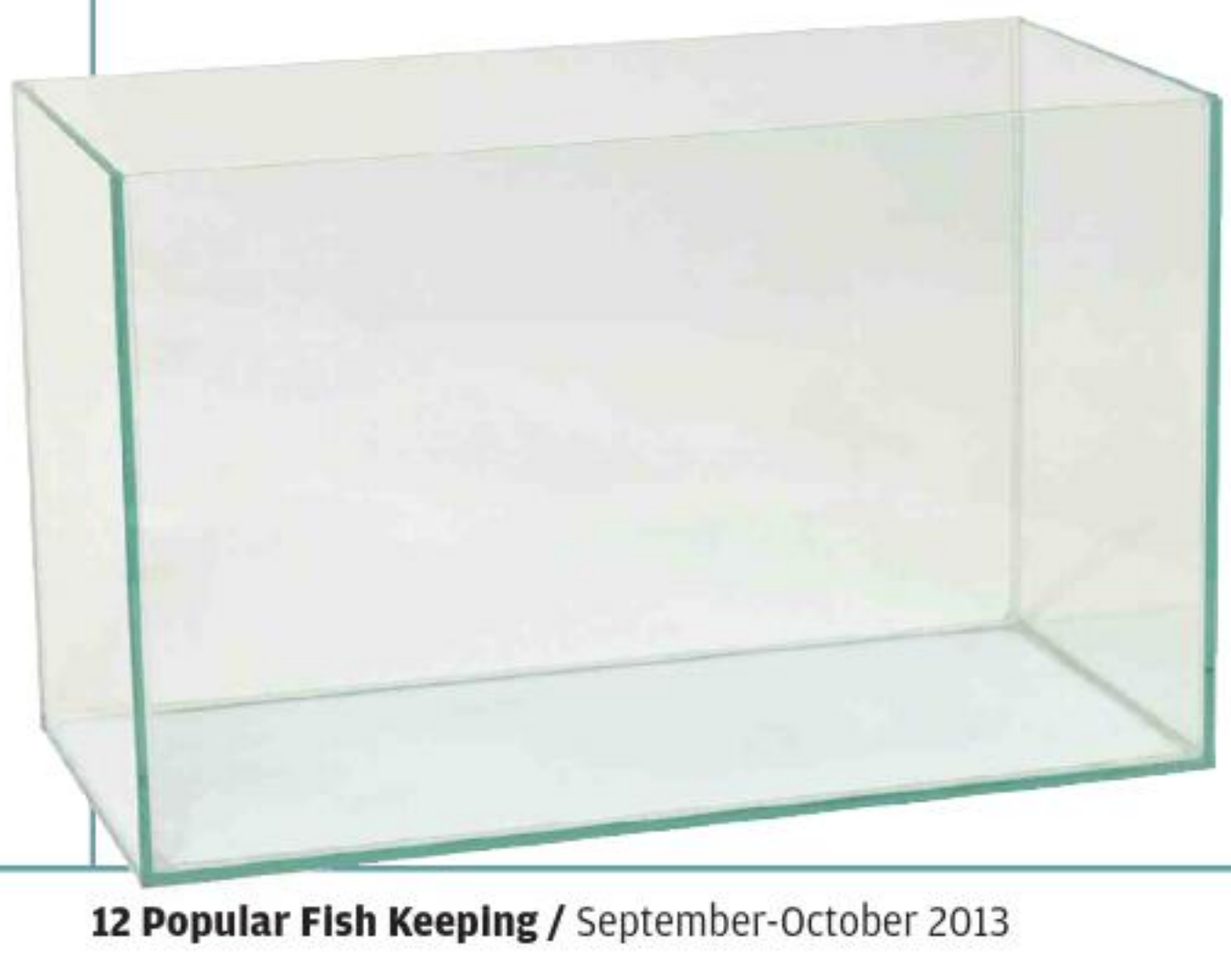
Enter these figures, press the calculate button and you will have the answer in a few seconds. This site also allows you to compute the volume of a cylindrical aquarium.

You then need to allow approximately 2l per cm (equivalent to 1gal per inch), based on the combined length of the fish. However, you also need to deduct 10-15% of the calculated volume, in order to allow for rockwork and other décor in the tank. This effectively then reduces the stocking volume.

Allow for growth!

The important aspect of both these measurements is that they refer to adult fish of your chosen species. Before actually acquiring any fish, you therefore need to sit down

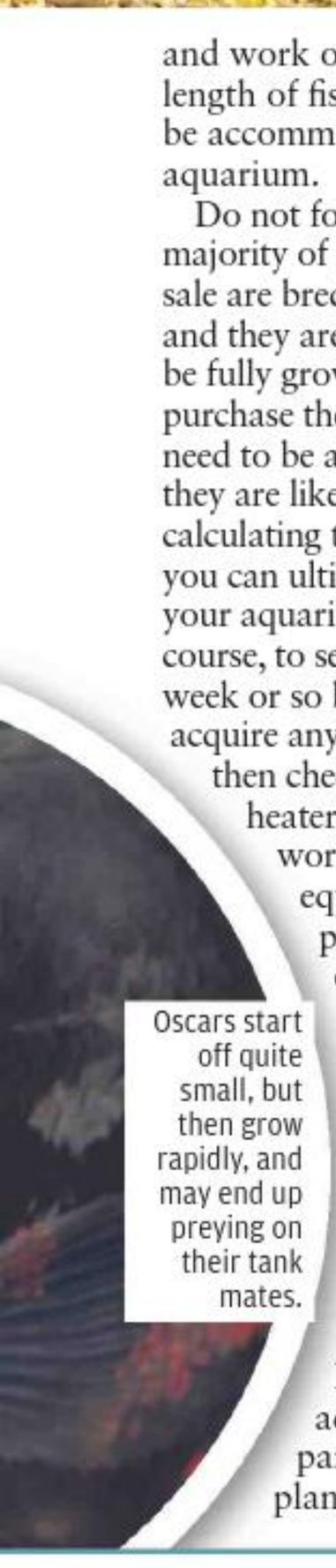
BELOW Tank measurements are vital when it comes to setting up a community aquarium.



Take care not to overcrowd the tank occupants.

and work out the total length of fish that can be accommodated in the aquarium.

Do not forget that the vast majority of fish offered for sale are bred commercially, and they are unlikely to be fully grown when you purchase them. You therefore need to be aware of how big they are likely to grow, when calculating the number that you can ultimately buy for your aquarium. It pays, of course, to set the tank up a week or so before you actually acquire any fish. You can then check that both the heaterstat and filter are working correctly, and equally importantly, particularly in the case of a mixed aquarium, you can set the plants in place, and give them an opportunity to start establishing themselves.



Oscars start off quite small, but then grow rapidly, and may end up preying on their tank mates.

Screening

In a mixed aquarium in particular, both the plants and rockwork have a function that extends beyond making the tank look attractive. They can be used to divide the aquarium into different areas, with the plants particularly providing screening, so that the fish not only have somewhere to retreat, but can escape out of the sight of possibly more aggressive tank mates.

Careful planting of this type, providing areas of relatively dense cover, can also help nervous fish to establish themselves in a relatively stress-free environment. They will venture out from the aquatic vegetation because they are confident they can dart back here if they feel threatened, whereas in more open surroundings, they will constantly be on the move, upsetting other tank occupants.

Rockwork and plants help fish to live in harmony.

Know your fish

Overcrowding is not simply a question of exceeding the calculated stocking density. It can also arise directly from your choice of fish. Remember that not all fish tend to swim at the same height in the water. You can see this from the appearance of the fish themselves, if you are in any doubt.

Some, such as plecostomus catfish, tend to occupy the lower reaches of a tank, using their sucker-like mouthparts to anchor themselves on bogwood for

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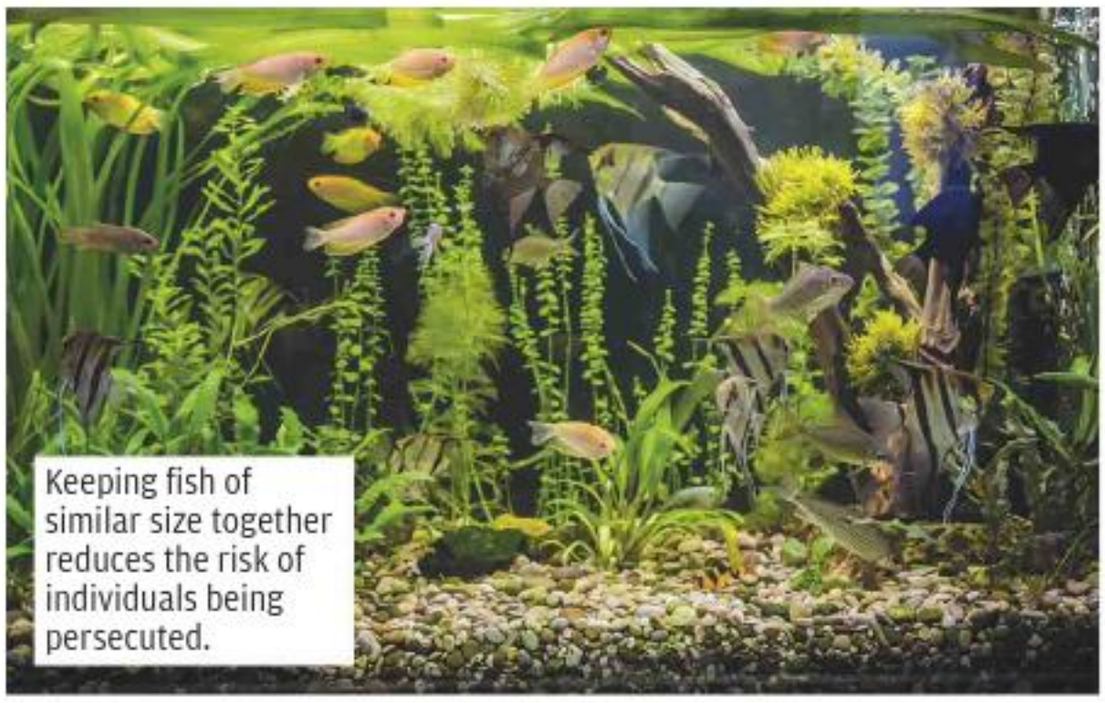


Keeping fish of similar size together reduces the risk of individuals being persecuted.

A plecostomus catfish, with its mouth beneath its body.

example. Bottom-dwelling fish also display a relatively flat underside to their body, allowing them to lie on the substrate without any difficulty.

Such fish are generally not fast swimmers, and so they rely more heavily on camouflage to escape the attention of would-be predators. In the case of these catfish as an example, their appearance may be mottled on their upperparts, but paler below, on the underside of the body.

Another characteristic of bottom-dwelling fish is that they tend to be nocturnal, proving to be less active when the aquarium is well lit. Since these fish feed on the bottom, so their mouths are located on the underside of their bodies too. The barbels of bottom-dwelling catfish tend to be quite short.

The situation is reversed in the case of fish such as hatchetfish that live near the water surface. They have a relatively horizontal back, so their presence will not be visible to would-be predators such as birds flying over the water, while the fish swim just below the surface.

You can also recognise fish that occupy the upper reaches of the water column by the position of their mouths, which are upturned. This is because rather than feeding beneath their bodies, this group of fish tends to snatch insects and other edible items from the water's surface, or even sometimes in the air above.

They will benefit from floating plants in the tank, beneath which they can hide away. In terms of food, items that float for a period, such as flaked food should be offered, whereas bottom-dwelling catfish are typically fed on pellets that sink through the water rapidly, in order to reach their target.

There is a third group of fish that have a different lifestyle though. These are fish that occupy the middle layer in the aquarium, although they will swim up or down, often depending on the availability of food. They tend to live in shoals, and have streamlined, torpedo-shaped bodies.

A red Jacob peacock cichlid (*Aulonocara jaconfreibergi*). These and other cichlids from the lakes in Africa's Rift Valley must be kept in hard water.

Their profile lessens water resistance as they swim – and they can accelerate rapidly if required, away from danger. In the wild, such fish are vulnerable to being attacked, being reasonably conspicuous as they move through open water. By forming shoals, so the chances of a predator picking off a particular individual are correspondingly reduced.

In order to create different focal points within a community aquarium, aim to include examples of fish drawn from all three groups. In addition, though, this approach will help to ensure the likelihood of conflict between different species of fish in the aquarium is reduced, as they tend to be less inclined to come into contact with each other.

Environmental considerations

Yet there are some obvious constraints when it comes to compatibility that have nothing to do with the behaviour of the fish, but rather relate to their physiological needs. Check the water conditions that they require. As an example, you cannot put any Rift Valley cichlids in an aquarium with Amazonian fish, which live in soft rather than hard water, unlike the cichlids.

Water temperature is less of an issue, but bear in mind that some tank occupants, notably White Cloud Mountain minnows (*Tanichthys albonuches*) prefer a lower temperature – around 18-22°C (65-72°F) in this case – than that within a typical tropical aquarium. If kept too warm, then their lifespan is likely to be shortened.

Right Neon tetras are one of the mid-level shoaling species. Note the position of the mouth, which lies at the front of the face.

Expert guide... to community harmony

- Find out about the adult size of fish that you are thinking of acquiring.
- Determine their temperament.
- Don't overstock the aquarium.
- Be observant and act if trouble threatens.

Some specific pointers

Tiger barbs may be included in a community aquarium, but unfortunately, they do have a tendency to nip at the fins of certain fish, particularly Siamese fighting fish and angelfish. They should therefore be kept apart from these fish.

Other barbs tend to be less inclined to engage in this vice, although the related zebra danio has a bad reputation in this respect as well. There is plenty of choice when it comes to deciding which fish you want to include as part of your aquarium though, so this should not be a problem.

Male Siamese fighting fish (*Betta splendens*) must never be housed together, because they are aggressive, and will attack each other. Yet you should also try to avoid fish displaying similar colouration to the male in the aquarium too, since they could end up being seriously harried as well. Given the range of colouration in the case of these bettas though, this too should not be a problem.

Keeping fish of similar size together reduces the risk of individuals being persecuted.

Buying the fish

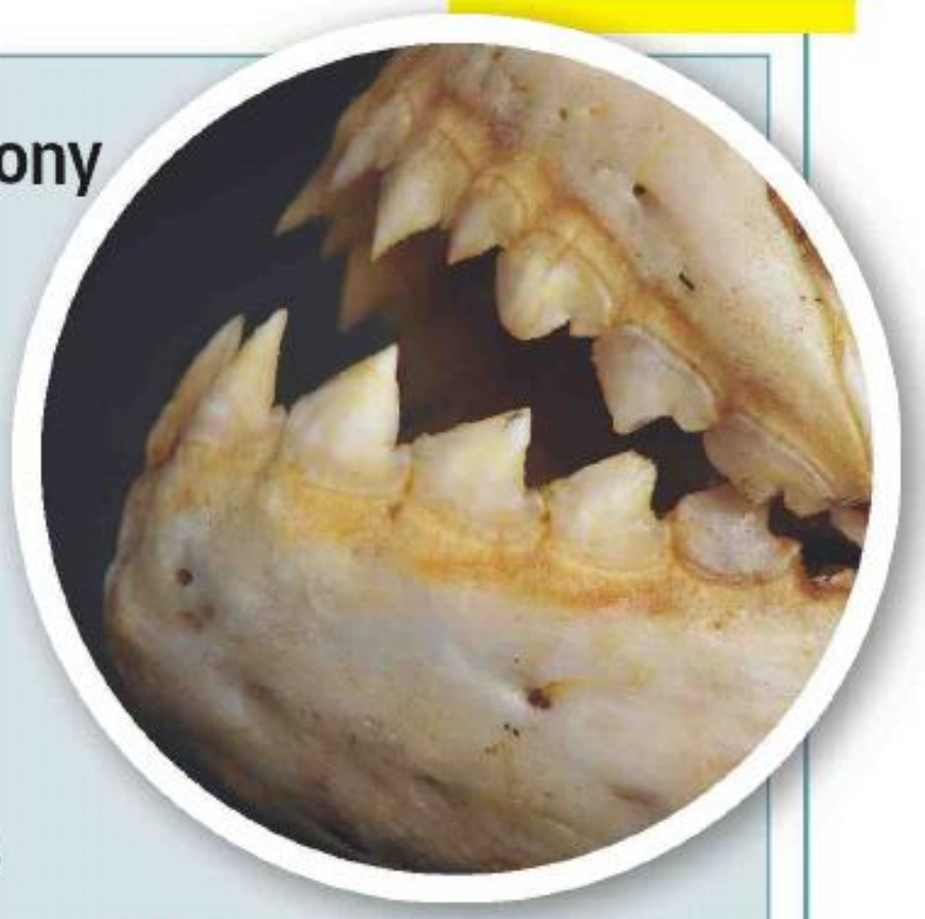
Armed with the stocking density figure based on your tank size, you can then go off in search of the occupants. Selecting the fish, once everything is set up, should be really enjoyable, but chose with care where you go to buy the fish. You want be sure that they are suitably acclimatised, and should settle without any problems. (This is discussed in more detail in the next article – ED).

Warning!

The impact of teeth can be important, when it comes to attempting to determine which particular fish will live together. Certain species such as piranhas have particularly powerful teeth in their jaws, which can be used to tear prey apart.

Yet it is the size of the mouth that is perhaps the key indicator in terms of determining the likely level of aggression of the fish concerned. Even those that lack teeth at the front of their mouths can still inflict a painful and damaging bite by simply relying on their strong jaws.

You may not see any overtly aggression, but simply find one or more of the fish in the tank have clearly been attacked. Do not ignore any nocturnal species that you have in the tank as possible suspects. It is not unknown for such fish to hunt down other species sharing their quarters after dark. The only solution in such cases is to remove the most likely culprits and hope for an improvement.

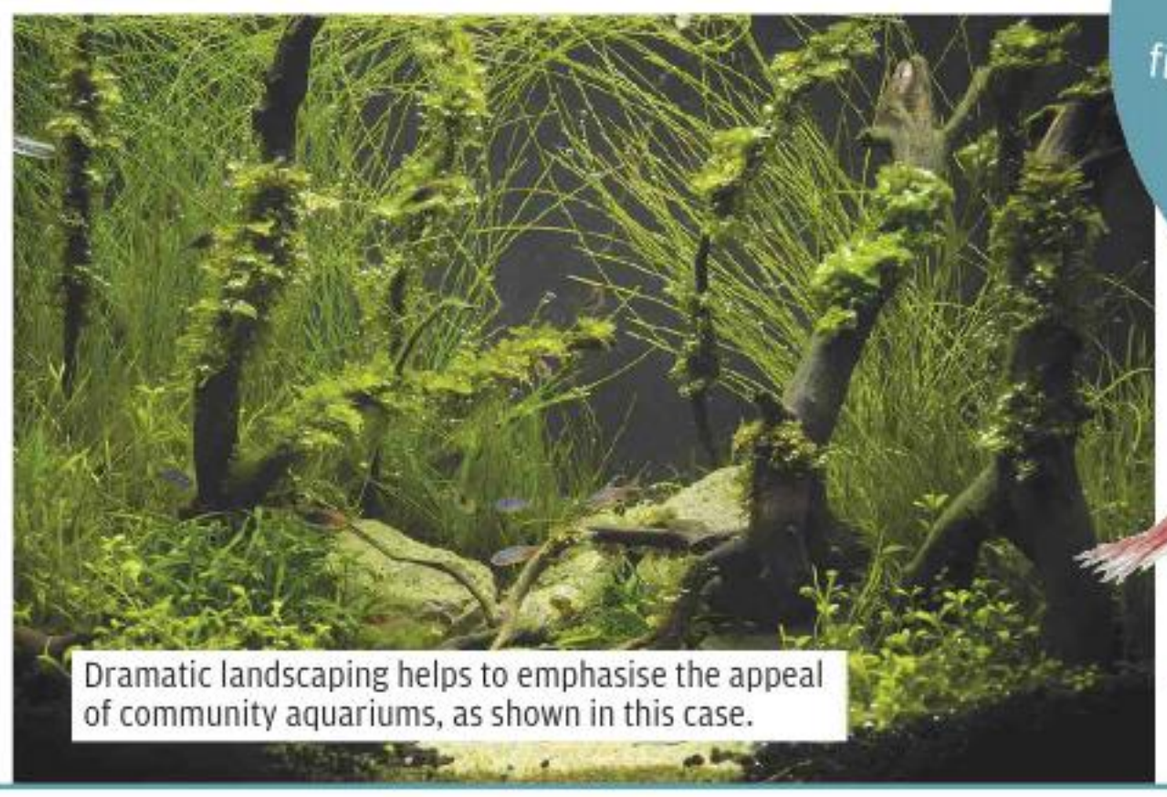


ABOVE A piranha's teeth seen in close-up in a museum specimen. It is easy to see why shoals of these fish are so feared in the wild.

Don't ignore the traffic lights!

When it comes to determining which fish will live together in harmony, help is often at hand in-store. Many aquatic shops provide information informally with their so-called traffic light system. If you are looking for fish that should be suitable for a communal aquarium, the you simply need to concentrate on those that have a green dot after their names on their tank labels.

Be wary with fish that are marked orange, simply because they may give rise to problems in these surroundings. Names of fish accompanied by red dots are usually too aggressive, grow too large or may have other particular requirements, such as preferring brackish water. This means that they will definitely be unsuitable for the typical community aquarium.



Dramatic landscaping helps to emphasise the appeal of community aquariums, as shown in this case.

DID YOU KNOW?

Be careful when choosing companions for Siamese fighting fish. They can be both aggressors and victims.

Themed tanks

These issues surrounding water conditions help to explain why so-called 'themed tanks' became so popular several years ago. The idea in such cases was to maintain a mixed collection of fish, while selecting those that occupied a particular area of the world, where they naturally co-existed. The planting and overall set up was a microcosm of their

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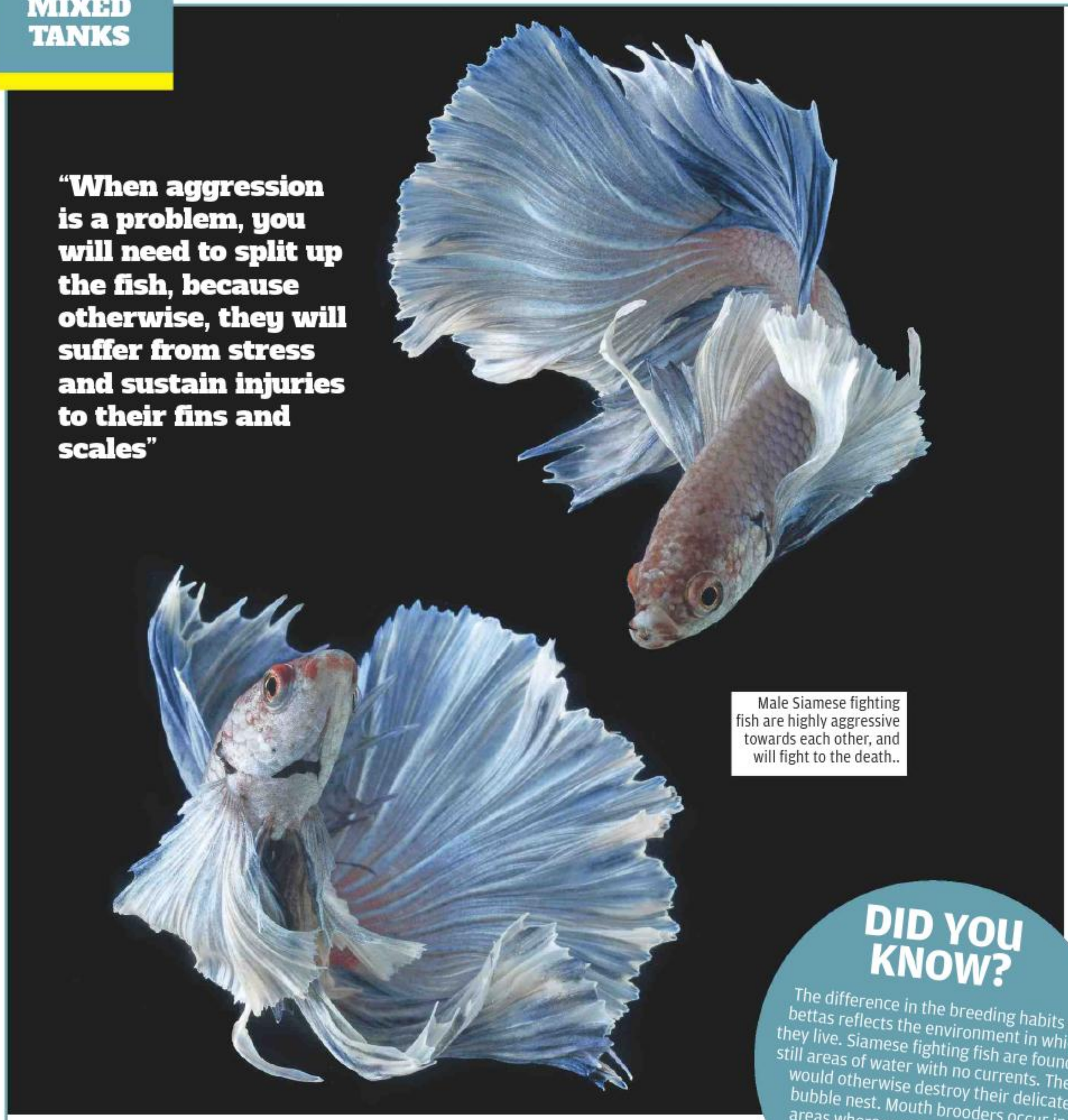

"When aggression is a problem, you will need to split up the fish, because otherwise, they will suffer from stress and sustain injuries to their fins and scales"

Male Siamese fighting fish are highly aggressive towards each other, and will fight to the death..

DID YOU KNOW?

The difference in the breeding habits of bettas reflects the environment in which they live. Siamese fighting fish are found in still areas of water with no currents. These would otherwise destroy their delicate bubble nest. Mouth brooders occur in areas where water currents are more powerful, and so it is believed that they collect their eggs, to prevent these from being swept away.

natural environment.

If you want to learn more about this trend, one of the best books that you can look at for inspiration, deriving in part from the photography, is *The Complete Aquarium* by Peter Scott, published by Dorling Kindersley back in 1995. Perhaps unsurprisingly, it is out of print now, but you can buy copies for just pence on internet sites like Amazon UK.

Signs of trouble

Aggression itself is relative – although certain fish offered for sale are predatory in their feeding habits, and clearly, this needs to influence their choice of companions. Other, more subtle factors can come into play at times though. Disruption within a settled mixed collection is most likely to occur as the fish mature, and come into breeding condition. They often become territorial at this stage.

Typical signs may include the dominant male being more brightly coloured than his companions, with persistent chasing of weaker rivals as well as females. In this case, aggression is likely to be focussed on other members of the same species sharing the aquarium, although again, fish of similar colouration may also be harassed. This is when the benefits of a well-planted aquarium will be very apparent. A male will often stop harrying a would-be rival if the other fish disappears from sight into vegetation or behind rockwork. When aggression is a problem, you will need to split up the fish, because otherwise, they will suffer from stress and sustain injuries to their fins and scales as well. These wounds can easily become infected with opportunistic fungal organisms that are likely to be present in the aquarium water, and will have to be treated. Rather than setting up another aquarium though, you may be able to readjust the décor slightly and accommodate a tank divider in the existing set-up, removing this barrier once the level of aggression has declined. Meanwhile, you can transfer the aggressive fish behind the barrier, allowing the others to carry on without any disturbance. As a general guide, even if your fish do breed successfully in the aquarium, the chances are that their eggs and young may not survive, unless there is plenty of cover in the tank.

Buying healthy fish: What you need to look for

The excitement is mounting – everything is set up and the electrics and filter are working, so now is the time to obtain some fish. But where should go, and what should you look for? It pays to do your homework. Otherwise, you could easily end up introducing disease to the aquarium, and creating problems for the future. **Greg Jennings** provides advice.

You can obtain fish from various sources, ranging from ordinary pet shops to specialist aquatic stores, and even via mail order. The choice may be influenced to some extent by the types of fish that you want, as much as any other factor.

Most pet stores stock a basic selection of tropical fish, usually including a selection of livebearers such as platies, maybe some barbs and similar species like rasboras, common tetras like the neon, plus a few of the smaller catfish like corydoras. These are usually quite suitable for a community aquarium, because if the shop only has a few tanks, then it will tend to stock the popular species that are easy to keep.

On the other hand, if you are seeking specific or more unusual species, it will be better to go to a specialist aquatic store. You can find a number advertising in this magazine, but if there is not one close to where you live, try an internet search, or ask for a local recommendation if you have some fish keeping friends.

Choosing a store

Once you have set up your aquarium, then clearly, it is tempting to rush out and buy some fish, but a hasty purchase may soon be regretted, so take your time, and do not place

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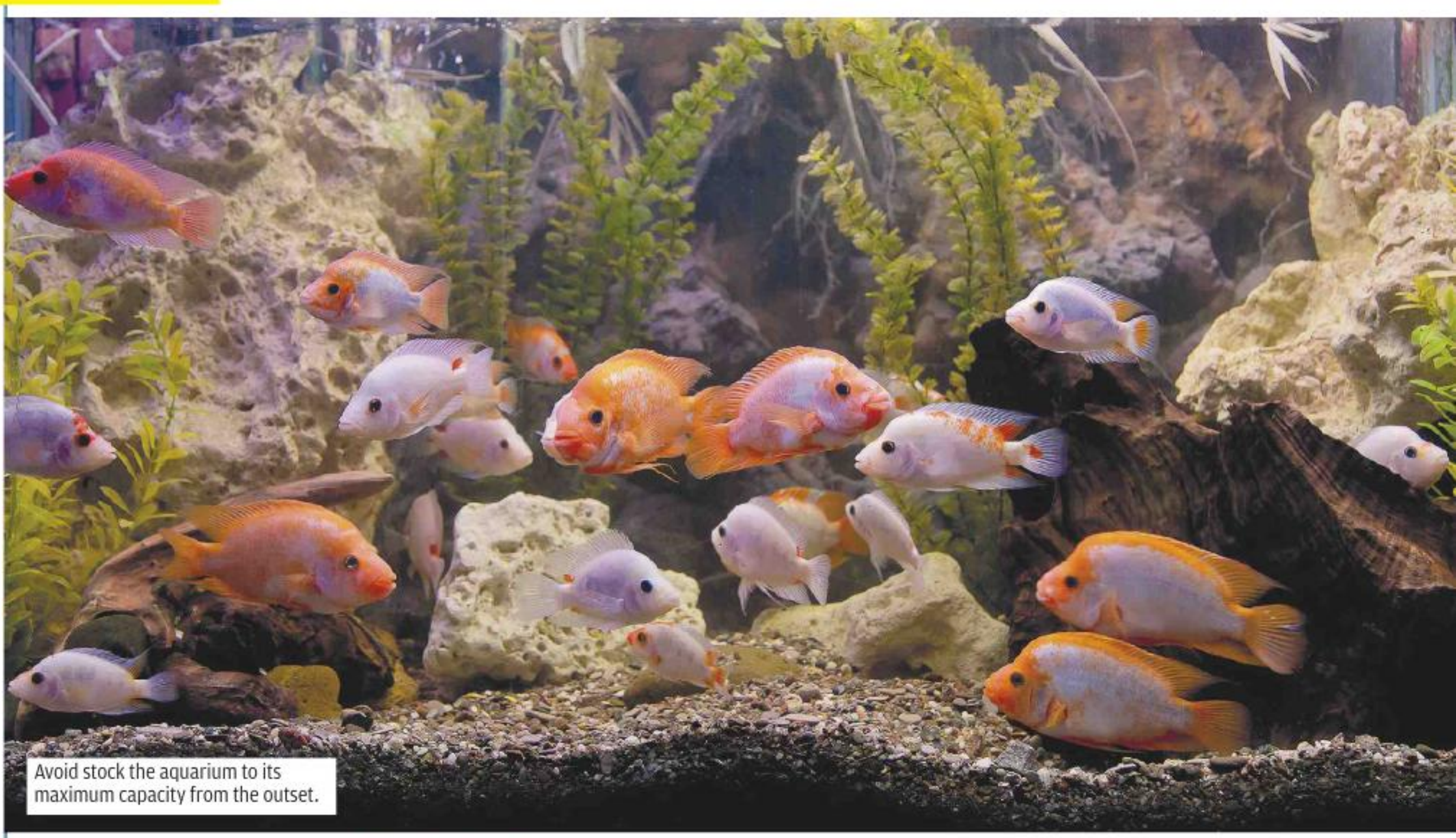
Corydoras are widely available, representing one of the most popular groups of aquarium fish.


It is important to study all the fish in the tank before deciding which, if any, to buy.



Avoid stock the aquarium to its maximum capacity from the outset.

yourself under pressure. If you are doubtful about the way that the fish are being kept at one store, or their condition, then err on the side of caution and look elsewhere.

The fish themselves are only a relatively small part of your outlay, compared with the cost of the equipment, but if you don't buy wisely, you could waste both time and money, landing yourself with a lot of frustration and additional problems right from the start.

Also, bear in mind that if you add sick fish to the tank, you will endanger the health of their companions, as well as any subsequent arrivals. Always aim to obtain the best stock that you can find, and keep newcomers after your initial purchase in a basic isolation tank at first for this reason. Even though this will not guarantee their good health, it will protect the established fish.

Buying locally

There are a number of advantages to obtaining fish locally where possible. In the first place, they are likely to be more acclimatised to the local water conditions, at least to some extent, depending on how long they have been in stock. They will also only have a short journey to their new home, lessening the stress of the move.

If you become a regular customer at your local store, you can easily keep a check on any new fish that become available. You are also more likely to get a helpful response in the event of any problems, and often free advice, which can be particularly important when you are new to the hobby.

Remember that dedicated aquatic shops provide far more than just fish and dry goods – the best ones are community hubs where fish keepers of all levels of experience congregate, getting to know each other and sharing their knowledge.

With a new tank, using a local supplier also makes it more convenient if you want to stock it gradually over a few months. This is often recommended, as the efficiency of the filtration system improves as the filter starts to work at maximum efficiency.

"If you don't buy wisely, you could waste both time and money, landing yourself with a lot of frustration and additional problems right from the start"

The size of larger fish such as discus will influence their cost, with large specimens being more expensive. Proven, compatible pairs or rare colours also tend to increase the asking price.

Popular Fish KEEPING

Expert tips

Store checklist

BELOW The fish should be swimming normally – only surface dwellers like hatchetfish should be up near the surface.

As with any type of store, some aquatic outlets are better and more informed than others. Although it may be tempting to rely on the length of time that a store has been trading, this can only be a guide; newly-opened stores can be very well-run, offering sound advice, as can chains of stores where there is usually a great deal of emphasis placed on training.

This approach may provide a uniformity of service and information that you will not necessarily find in independent outlets. Some of these will be very knowledgeable, and others less so. Independents often tend to specialise, having an area devoted to catfish for example, alongside other fish, making it easier to track down a particular species.

The following tips should help you to check, irrespective of the type of store, whether it is generally good for obtaining healthy fish:-

1. Trade membership

Although it is not a cast-iron guarantee, look for a store that displays current membership of a trade organisation, and particularly the Ornamental Aquatic Trade Association (OATA). Such bodies run special staff training courses, so the personnel in these outlets should be able to offer you sound, knowledgeable and up-to-date advice, on all aspects of aquarium management. Many independent outlets belong to OATA.

DID YOU KNOW?

It is a good sign if the shop uses different nets, which are disinfected regularly. Nets can spread disease easily from one tank to another, through contaminated water.

2. Sick fish

Avoid any store where you spot dead or diseased fish on view. Yes, fish occasionally do die in stores, just as they do in home aquariums and in the wild, but leaving them on view suggests a lack of attention to detail, and the welfare of the other fish.

The overall state of the tanks will give a general indication about the store. Be certain that they are clean and not overcrowded. In some cases, there may be a label, saying the fish in a particular tank are in quarantine. This can be frustrating if you want to buy some when you visit, but it is actually a positive sign in terms of helping to ensure that you do not walk out of the store with sick fish.

3. Air supply

If the fish are congregating at the surface (as distinct from recognised surface-dwellers such as hatchetfish), and particularly if they are gasping, they may be suffering from an oxygen deficiency and therefore under stress, making them more vulnerable to infections. These can then develop in your tank at home. This suggests poor management in any case.

4. Clear, detailed labelling

A fairly reliable sign of a well-run store. The labelling may highlight the compatibility of the different fish and other details such as their ease of care, quite apart from their price. This suggests a knowledgeable and responsible management.

5. Helpful staff

Watching the staff at work can give you a useful insight, particularly with regard to their attitude to other customers. Are they happy to talk about the fish, being enthusiastic and helpful, or are they offhand? Should you or another customer want a particular pair of fish in a tank, but the staff seem unwilling to catch them up for you to look at, trying to fob you off with others instead, then you may well prefer to go elsewhere.

It usually takes up to two months to reach this point, after having set up the tank. For this reason, it is not a good idea to add fish up to the maximum stocking density from the outset. The filter could easily become overloaded, affecting the health of all the fish as a result.

Ordering fish

If you cannot see the particular species that you want, a store may be willing to order the fish especially for you, particularly in the case of a specialist aquatic outlet. They may only be prepared to do this for a firm order though, which rather binds you to buying the fish before seeing it, which is not generally recommended. If the dealer seems knowledgeable and the premises are well run though, you may want to take the risk, with the proviso that if the fish has a problem, such as missing scales, then you will be entitled to cancel the order, having being able to inspect the fish.

When seeking breeding stock, it become more complicated, unless the sexes of the species concerned can be discerned very easily, so there is no scope for confusion.

Mail order fish

Perhaps unsurprisingly, the least satisfactory option, in general terms, although it may work well in individual cases, is to buy fish unseen from someone in another part of the country, and have them sent to you by courier. Shipment is quite costly under these circumstances, often being well in excess of the price of the fish themselves, and so this method only tends to be used with more expensive fish - typically breeding stock.

Under these circumstances, the breeder or supplier may well be willing to supply you with photos online, even if they are not on their website. This is definitely to be recommended, as it gives you an opportunity to see the fish before they are dispatched to you.

Always check when the fish will be sent – some suppliers

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BELOW Show stock is more uniform in appearance. A sunset marigold hi-fin platy is seen here.

Some catfish are more active than others.

"It is obviously helpful to visit shows, because this will give you a clear indication of the type of fish that you need"

Obtaining oscars as young fish brings benefits.

have set dispatch days each week. Consignments can usually be tracked on route, and you probably be given a delivery window of an hour or two, to ensure that someone will be at home to receive the fish.

They will be shipped in special insulated boxes, with heat packs so they will not be subjected to great variations in water temperature, although shipping is usually delayed if the weather forecast is bad, so as to ensure that the fish do not be stranded. Obviously, if there are lengthy, unexpected delays in transit, this may harm the fish.

They need to be unpacked and placed in an aquarium as soon as possible once they reach you, but do not forget to allow the bag to float on the water surface in the tank for 15-20 minutes, to equilibrate the water temperatures, before releasing the fish.

Show stock

If you are interested in keeping and breeding exhibition stock, then you may need a different approach. It is obviously helpful to visit shows, because this will give you a clear indication of the type of fish that you need, quite apart from allowing you to see the winning entries at such events.

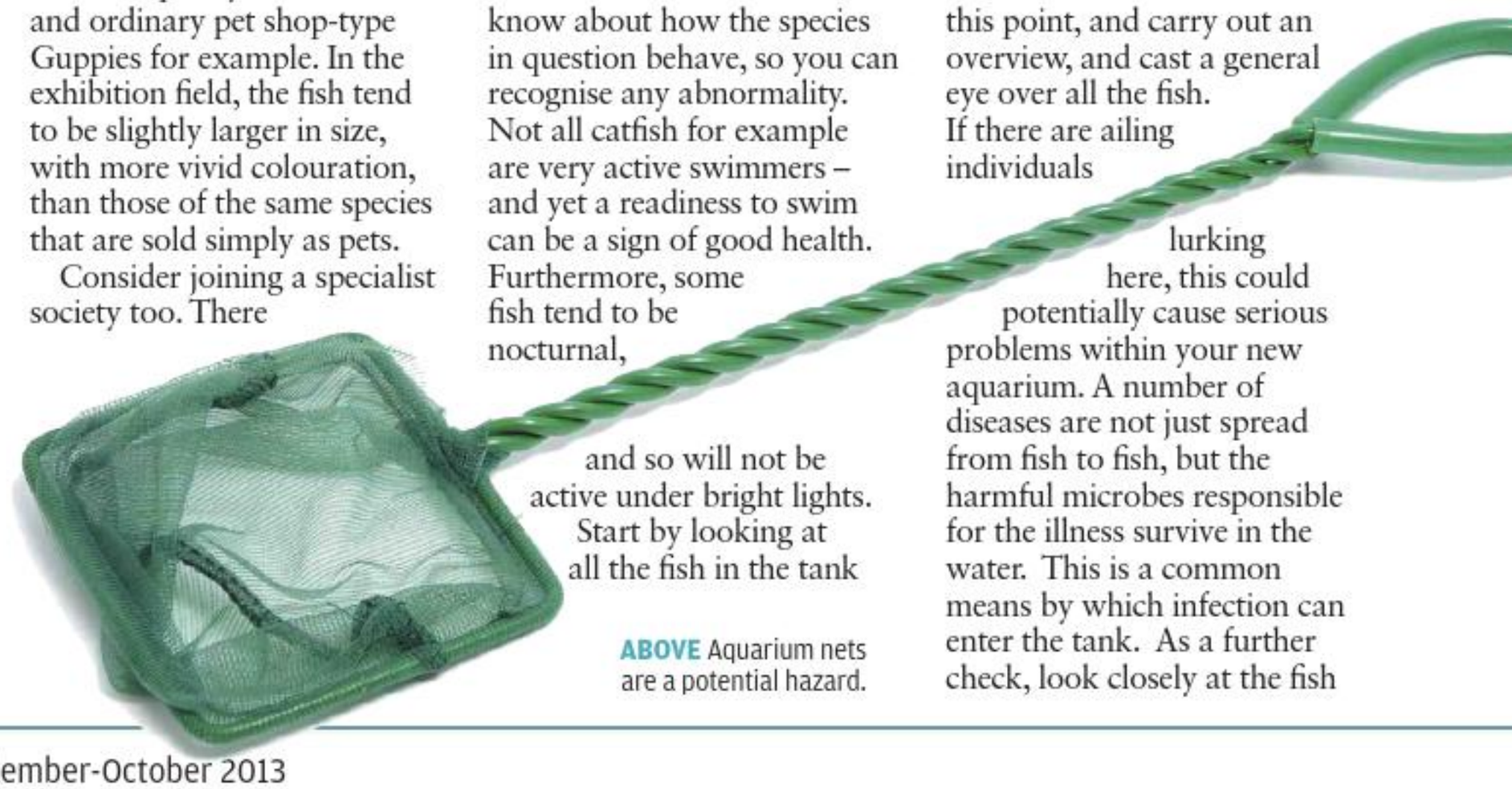
Attending shows also provides the best way of meeting breeders as well. They may have surplus stock available, either on-sale at the event or at their homes, or may be able to recommend other exhibitors who can help you to set up with good stock.

As you will see, there is a considerable variance between quality exhibition and ordinary pet shop-type Guppies for example. In the exhibition field, the fish tend to be slightly larger in size, with more vivid colouration, than those of the same species that are sold simply as pets.

Consider joining a specialist society too. There are organisations representing all the major groups of fish. This will put you in touch with dedicated and experienced enthusiasts, and in addition to advice, this can also give you access to more unusual species that would be hard to obtain from the average aquatic outlet.

Selecting your fish

When it comes to choosing the fish themselves, allow time to watch and observe them, before reaching any decisions. It is not just about inspecting their condition. You need to know about how the species in question behave, so you can recognise any abnormality. Not all catfish for example are very active swimmers – and yet a readiness to swim can be a sign of good health. Furthermore, some fish tend to be nocturnal, and so will not be active under bright lights. Start by looking at all the fish in the tank before deciding which – if any – you want to purchase. Stand back from the tank at this point, and carry out an overview, and cast a general eye over all the fish. If there are ailing individuals lurking here, this could potentially cause serious problems within your new aquarium. A number of diseases are not just spread from fish to fish, but the harmful microbes responsible for the illness survive in the water. This is a common means by which infection can enter the tank. As a further check, look closely at the fish



ABOVE Aquarium nets are a potential hazard.

after they have been caught, and are in the clear plastic carrying bag, to be sure that they are no obvious signs of any problems.

Start small...

It is almost impossible with most tropical fish to be sure of their age, especially if they are fully grown when you acquire them. Small species such as livebearers may live for little more than a year, so buying them is something of a lottery. Although less impressive in some cases, it is usually better to choose young fish because it is easier to determine their age – or at least be sure that they are relatively young.

Even with fish such as oscars (*Astronotus ocellatus*) that grow to a larger size and can live for a decade or more, it may still be better to select smaller individuals. They will be cheaper, and perhaps more importantly, they will usually settle down more easily in new surroundings. This is especially important with "character" fish such as oscars that can be taught to feed from your hand.

Furthermore, if you are hoping to breed from a pair in due course, then this approach can also be helpful in the longer term. It allows a pair bond to develop naturally within members of a group, and since none of the fish are likely to be ready to spawn, so the male will not be inclined to bully the female when they are transferred to unfamiliar surroundings. This is otherwise something that you may need to watch, with female fish of this type often taking longer to settle down than males.

A closer examination

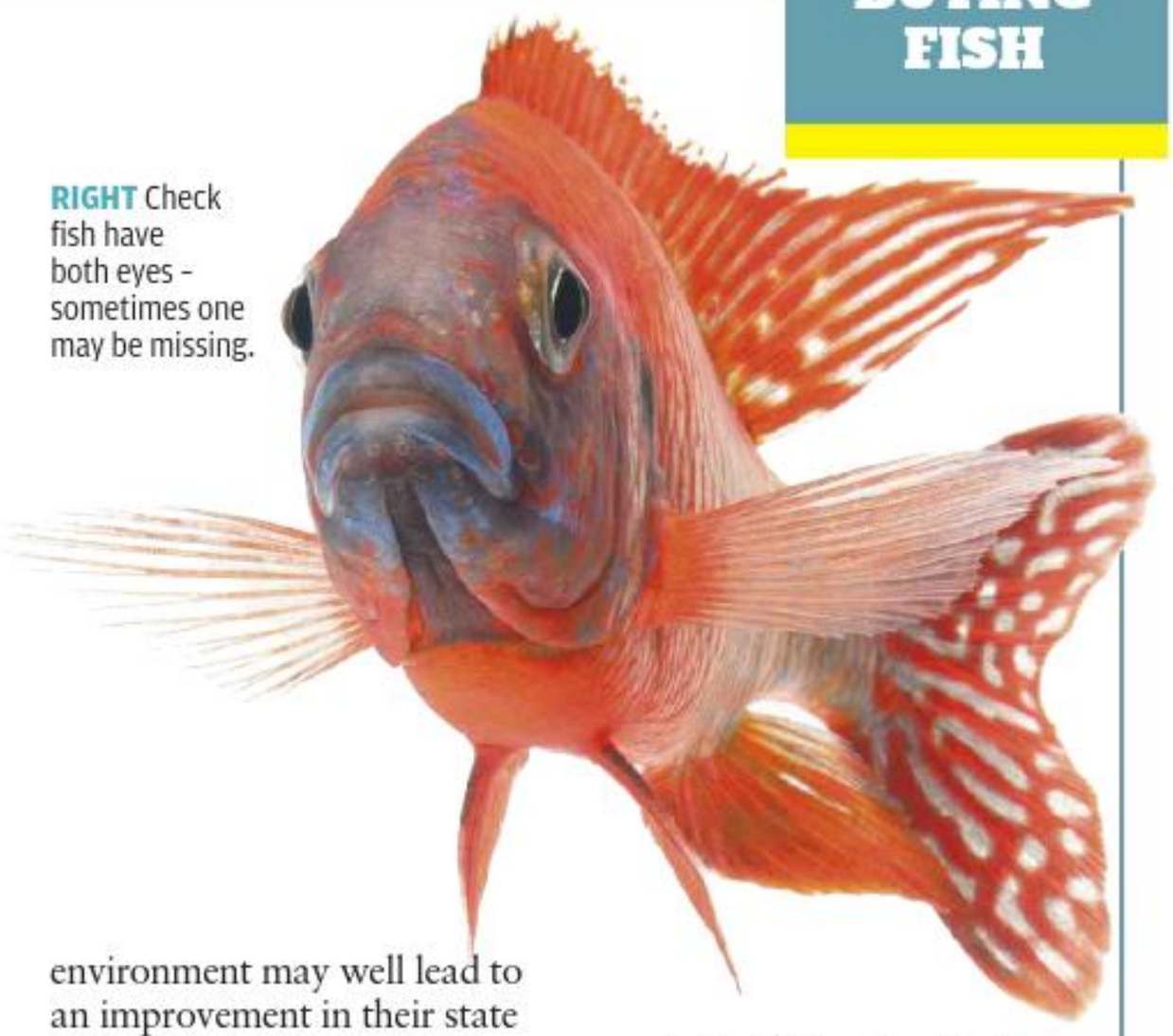
Here is a checklist of points to watch for, to help you avoid the risk of selecting poor or unhealthy specimens.

1. Swimming indicators

These are very important. Are the fish swimming normally, and not tilting or encountering difficulty in maintaining their balance in the water? Any that appear to be having difficulty may be displaying signs of dropsy, particularly if their abdominal region appears slightly swollen, or a swim-bladder disorder, for which there are no real cures.

2. Barbels

It can be harder to assess the health of some fish, notably those catfish that are relatively inactive by nature. But check the barbels around the mouth are of even length and do not appear to be inflamed. This can happen, particularly if the substrate is dirty. Inflammation may extend to their underparts in this case as well. While a change of environment may well lead to an improvement in their state of health, the damaged area could still be susceptible to fungal or bacterial attack.



RIGHT Check fish have both eyes – sometimes one may be missing.

3. Body condition

Healthy fish should appear plump, and never thin, which could be indicative of a chronic disorder and even piscine tuberculosis. It is obviously easier to assess their condition when several of the same type are in a tank together. Bear in mind though, that young fish will be smaller, while the bodies of females will swell when in breeding condition, plus in some cases, there may be a difference in size between the sexes.

4. Eye check

Make sure that the eyes are not cloudy, and that both are present (except in the case of blind cave fish, where no eyes are visible). Occasionally, fry may develop with only one eye – perhaps most commonly in goldfish. Although unsightly, this need not be a significant handicap, because they will find their food by scent. Nevertheless, do always ensure that both eyes are present – this problem is not always immediately apparent, as the fish will seek to keep you in focus with its good eye.

If one or both eyes are bulging out abnormally (not to be confused with the telescope eyes of some goldfish), then this may indicate a condition described as 'pop eye', or more technically as exophthalmia; do not buy such fish, as they often do not have a realistic hope of recovery.

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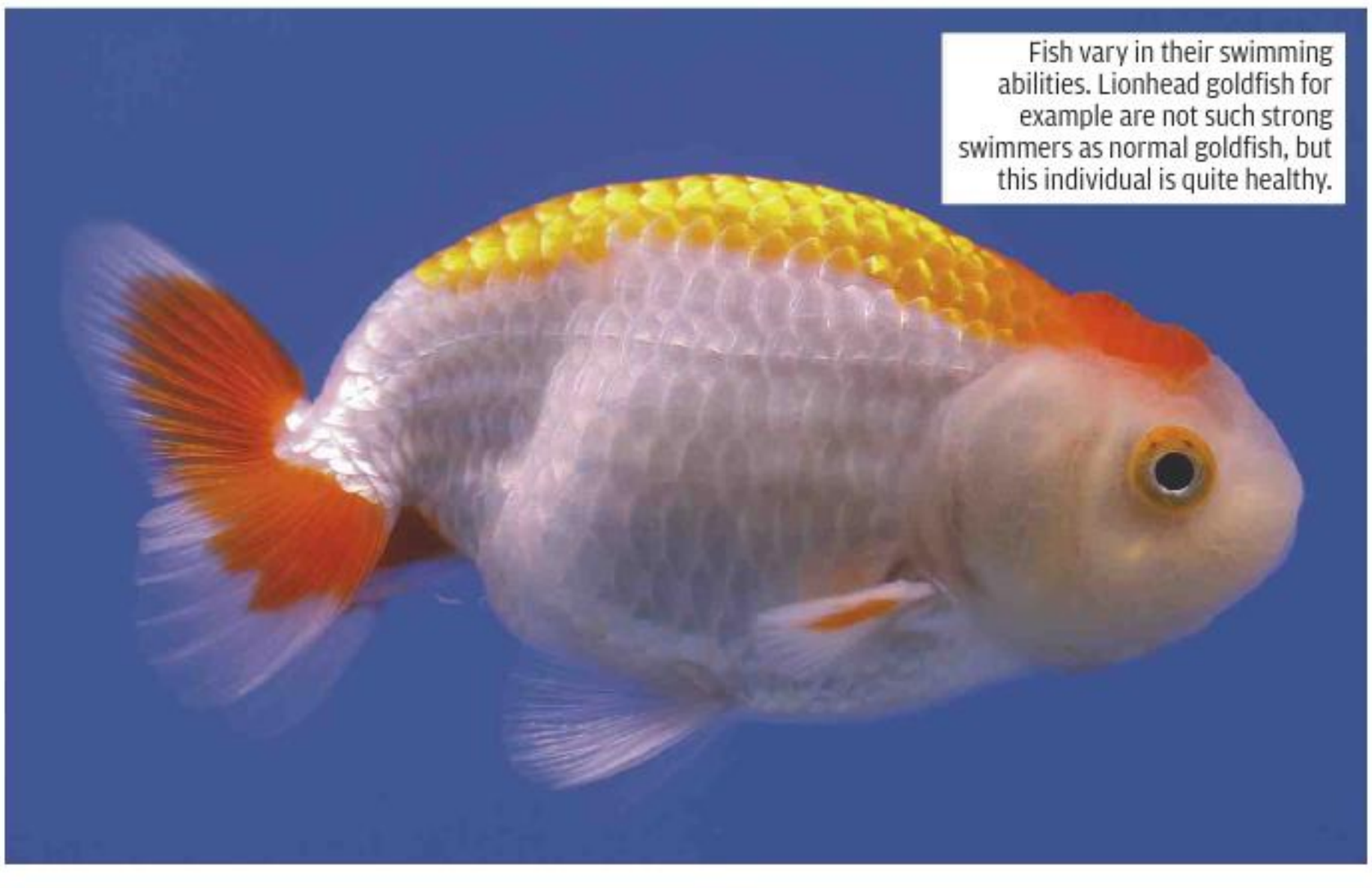

Fish vary in their swimming abilities. Lionhead goldfish for example are not such strong swimmers as normal goldfish, but this individual is quite healthy.

Pay particular attention to the condition of fish with long fins, like angelfish.

Further key indicators

The condition of the fins is very important, especially in the case of those fish with prominent or elaborate fins. In some cases, you may notice a few small nicks, particularly in the dorsal and caudal fins, although these should normally heal, especially in clean water, without a problem. There is a slight risk of a fungal attack in the meanwhile.

Much more worrying is when the fins are kept closed or clamped abnormally, as this is often a sign of general ill-health, especially in fish that are naturally active. Severe erosion around the edges of all the fins is highly suggestive of either a weakened fish and/or poor water conditions. Such individuals may not recover, even with careful management, and are likely to be a hazard to others, and so should be avoided.

Scale damage – make a careful inspection of the fish's scales, because if there is a damaged area here, it can soon become infected and will start to ulcerate, with the visible area of injury expanding out from the central area. While ulceration can be treated successfully, particularly in larger fish, this is likely to be a costly and worrying process. Also, even if the fish does recover, there may well be some permanent scarring here.

Raised scales, held slightly away from the body, are an indicator of general illness and are often seen in association with other symptoms, such as a reluctance to swim and a swollen abdomen. Avoid any fish like this because they are likely to be seriously ill.

Eating is generally a sign of good health.

A final warning!

When selecting fish for purchase, if there are obvious signs of a problem such as the parasitic ailment known as ick or white spot (see page 86-7 for more information – ED) on some of the fish, then it really will pay to shop elsewhere. In addition to the risk of introducing the infection to the aquarium via the water from the tank, even if the fish you choose seem healthy, there is still a risk that they could develop the infection, especially after being transferred to new surroundings.

The last thing you want when setting up a new aquarium is to start having to medicate the water. This applies particularly with a disease that can lie dormant and then flare up again unexpectedly in the future.

You may even want to invest in a separate quarantine tank for all new fish. This can be a fairly basic set-up, consisting of a tank, a heaterstat and protective grill, plus a power filter, along with a thermometer. Keeping the fish here initially for a couple of weeks, before introducing them to the main aquarium, will provide another barrier in terms of disease control.

Popular Fish Keeping – Expert help with... colour change

In some cases, fish may exhibit poor colouration. If all the individuals in a tank are less brightly coloured than you would normally expect, it may well be that the lighting is too bright, which tends to make their colours appear less vivid.

A pale, washed out appearance is typically associated with many types of tetra housed under these conditions. In the wild, these fish often inhabit areas of water where the level of illumination is relatively subdued; if housed under such conditions, and especially if provided with some cover in the forms of floating plants, their colouration will very quickly become more vibrant again , typically in just minutes.

BELOW Here are two different photographs of cardinal tetras, showing how bright light, reinforced by pale gravel, impacts on their colour. The fish photographed on its own displays the typical colouration of the species, in darkened surroundings. This change is very temporary, and not of significance in terms of their health.

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?**

Piranhas should be kept in small shoals, but they are not ideal aquarium occupants.

A fearsome reputation

Q I'm planning on setting up an aquarium. Just how aggressive are piranhas? Do they make interesting tank occupants?

A Piranhas are the most notorious and feared of freshwater fish, with a mouthful of sharp teeth, although tales about their aggression are often exaggerated. Nevertheless, there is no denying that they have a very belligerent side to their natures, especially when they are in a feeding frenzy. This can even cause problems in aquarium surroundings.

As an example of what can happen, Percy, a piranha being kept at Aberdeen University in Scotland, swallowed one of the rubber suckers used to attach equipment to the side of his aquarium. A delicate operation was then required to remove the piece of rubber from Percy's digestive tract, allowing him to recover.

The outcome was less favourable for another piranha, however, who probably ranks as the largest ever kept in the UK. Also called Percy, this fish grew to a length of 33.7cm (13.25in). Unfortunately, he sparked his own demise by biting through the cable running to his aquarium heater, possibly mistaking it for a worm, and electrocuted himself instantly as a consequence.

Although red-bellied piranhas (*Serrasalmus nattereri*) have sharp teeth in their mouths, they are not particularly active fish, resting in the same part of their aquarium for long periods and only become active when being fed. Not the best choice therefore, if your aim is to keep lively fish.

In addition, piranhas will become increasingly aggressive as they mature, with smaller and weaker individuals likely to be preyed upon by others sharing their accommodation. You might well end up having to separate members of a group therefore, which will cause problems. Particularly if you're starting out therefore, consider some other types of fish that will be easier to manage.

Seeking something unusual

Q What are some of the more unusual fish that are popular with fish keepers?

A Camouflage can come in a variety of forms, and a number of tropical freshwater fish have evolved transparent bodies. The so-called x-ray tetra (*Pristella maxillaris*) and Asian glass catfish (*Kryptopterus bicirrhis*) are typical examples.

The bones of the fish's body and even its body organs may be visible in such cases thanks to the lack of pigment, but you can pick up the subtleties of their colouration by keeping such fish above a dark substrate. The glass catfish for example has a slight purple hue behind the gills.

Their transparent appearance actually helps to conceal the presence of such fish however, particularly in well-planted environments where their bodies merge into the background of their surroundings. Not surprisingly, both these particular fish have become popular with fish keepers because of their unusual appearance and their general ease of care.

Another bizarre fish originates from a series of caves in Mexico, and is now very widely kept in the aquarium hobby today. The blind cave fish (*Astyanax mexicanus*) is not actually blind when it hatches, but skin grows over its eyes, obscuring its vision. Its body is pinkish-white, having no pigment as with many cave-dweller species.

"Bones of the fish's body and even its body organs may be visible"

Within the confines of its dark subterranean world, the blind cave fish would derive no benefit from eyesight. Instead, it relies on its lateral line, which is a jelly-filled canal that runs down each side of its body and detects vibrations caused by movement in the water. This allows this member of the tetra clan to locate its food, find its way around and escape danger. Interestingly, in the home aquarium, these fish are virtually as adept at finding food as similar characins with normal eyesight.

It appears that the ancestors of these fish were somehow swept into the caves from the rivers above, where their rather plain-looking relatives are still to be found. They then developed their distinctive appearance below ground over many thousands of years.

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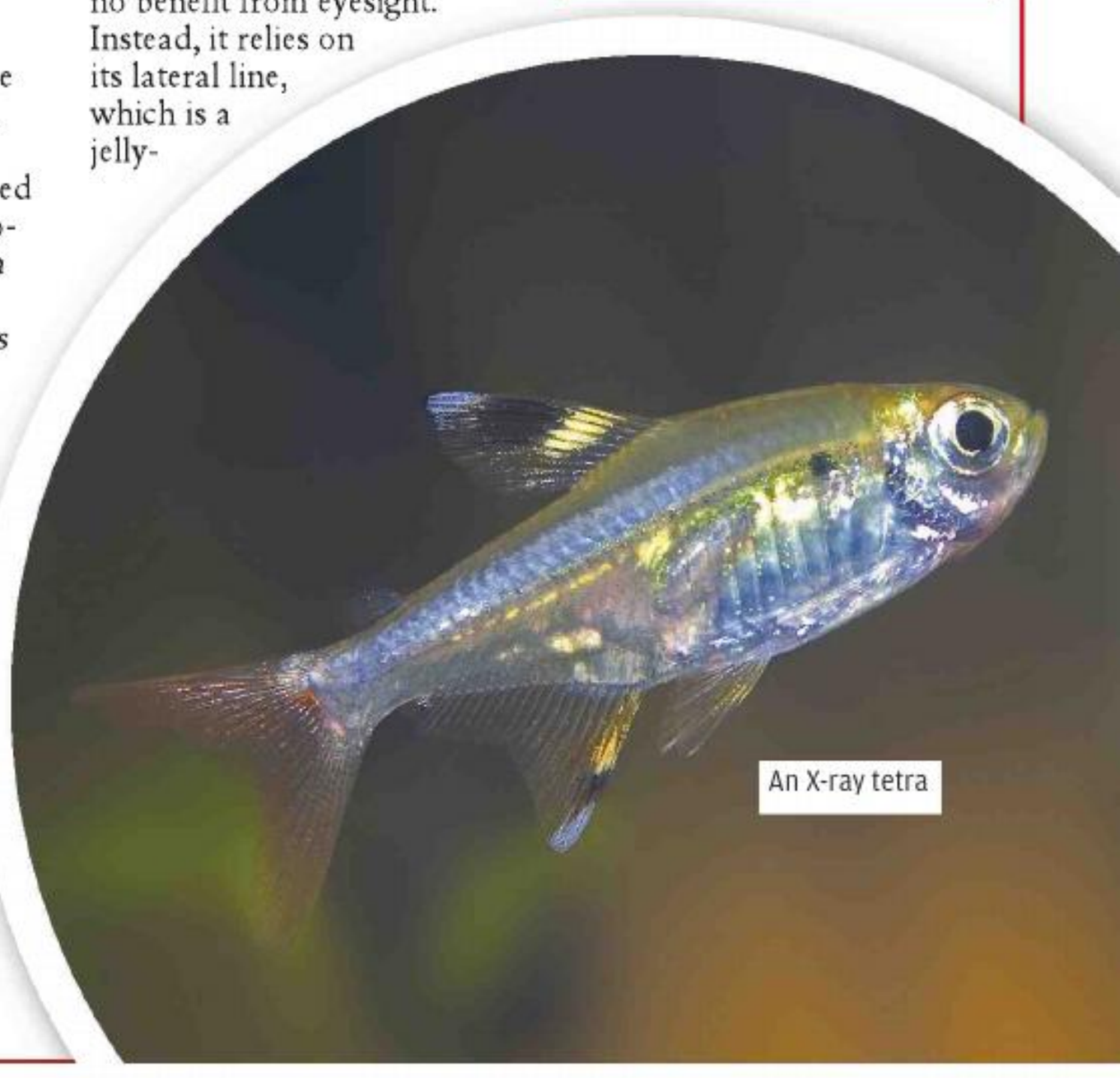


An X-ray tetra

Barred sorubim (*Pseudoplatystoma fasciatum*) – a predatory, nocturnal catfish, as revealed by its appearance. It can grow to 104cm (41in).

"Likened to a cat's whiskers, these sensory devices are called barbels"

LEFT Discus can be costly. This individual is an example of the red melon strain. True reds were very expensive when they were first bred.

Money matters

Q What are the most costly aquarium fish to buy?

A This group includes rare and striking new colour variants of discus (*Symphysodon* species), which are sold for breeding purposes to commercial collectors. Such fish may often be displayed at leading Oriental fish shows. Also in the Far East particularly, arowana (*Scleropages aureus*) are sought-after fish, commanding a potentially very high price.

Some of the more unusual catfish can be very expensive as well, selling for more than £1000 in exceptional cases. Catfish, however, represent one of the most diverse groups of all the fish kept in home aquarium, both in terms of their size and shape. They can usually be distinguished, however, by the presence of projections around their mouths.

Likened to a cat's whiskers, these structures are called barbels. They have an important sensory function, helping the catfish to find its way around and seek food in what are often murky surroundings, although the length of the barbels can be very variable between different groups.

Not all of the world's 2,000 or so catfish are sedentary by nature; some live in fast-flowing areas of water and are streamlined predators. The shape of the barbels can give a further clue to an individual's lifestyle, since those catfish with long and often slender barbels are typically hunters rather than scavengers. They are often nocturnal hunters, or may naturally occur in very turbid water in the wild, where visibility is restricted.

This arrangement clearly provides more extensive sensory details about the fish's environment and possible prey rather than short barbels that are most useful at close quarters. The appearance of the barbels can therefore be helpful in determining which species can be housed safely with other fish.

Breeding interest

Q Which fish are the most interesting to breed?

A Many species have no parental instincts whatsoever, to the point that they will consume their own eggs as these are laid. There are a few exceptions however, typically within the cichlid group, such as the mouth-brooders originating from the Rift Valley lakes of Africa, as discussed elsewhere in this issue.

Females in such cases actually gather their eggs, keeping them in their mouths without feeding often for about three weeks, until their young hatch. Even then, if threatened, the young cichlids will dart back inside their mother's mouth for safety.

In Central and South America too, cichlids often display parental care towards their eggs and their young. Angelfish (*Pterophyllum*) for example guard their eggs and will watch over their young at first, shepherding them from danger as far as possible.

Within the

Striped anostomus.
PHOTO COURTESY BRIAN GRATWICKE

Amazon basin, there is another cichlid that displays an even more advanced form of parental care. Discus choose their spawning site together, cleaning the rockwork or leaves where the female lays her eggs, and the pair will guard them until hatching occurs. Then once the fry are have absorbed their yolk sacs and are free-swimming, they will start nibbling at the sides of their parents, feeding on a special mucus secretion produced for them.

In some cases, the adult fish may initially eat their eggs, but do not despair - once they are more settled in their surroundings, breeding is likely to progress without problems. You will then be able to watch this amazing behaviour at close quarters.

Upside down

Q We've recently added a long-bodied fish called a striped anostomus to our aquarium, but we don't know much about it. It seems to be feeding well, but appears to be having difficulty in maintaining its balance. It spends time with its head pointing downwards. Is there anything we can do? Could it be suffering from a dietary deficiency?

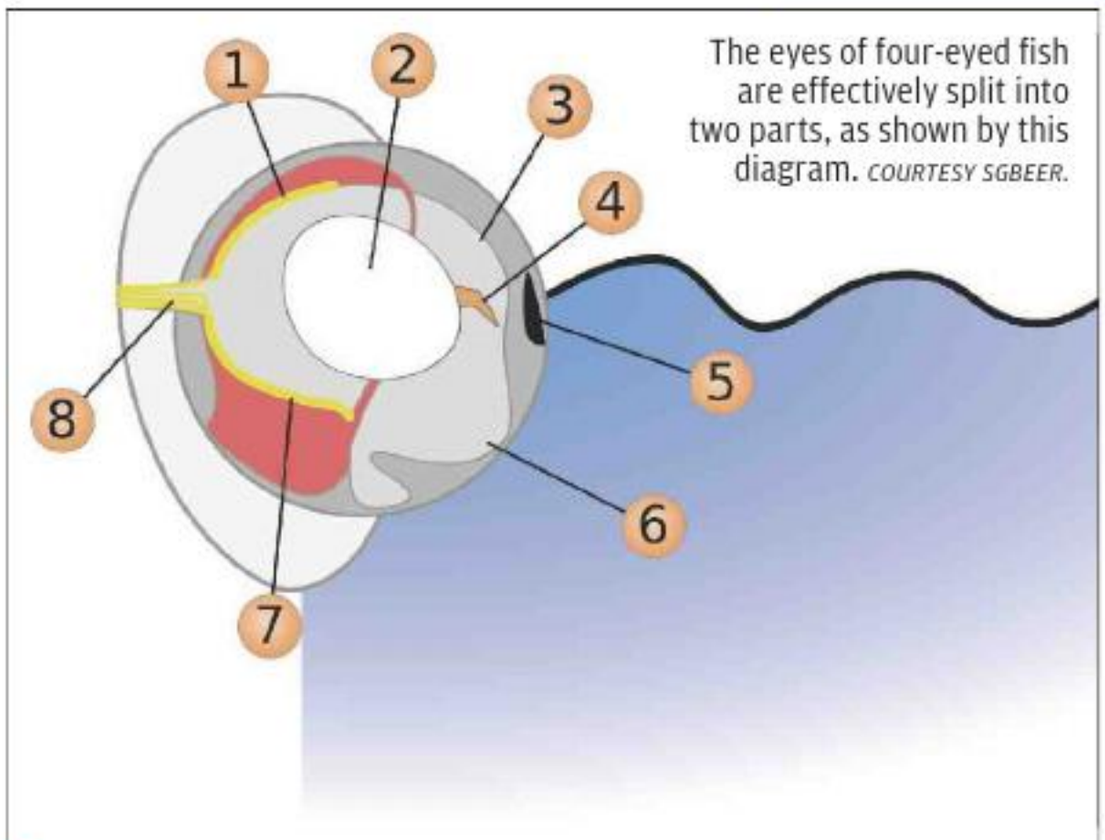
A There's no need to worry. This is quite normal behaviour for these and other anostomus fish, and is the reason why they are also sometimes known as headstanders. Striped anostomus (*Anostomus anostomus*) are mainly vegetarian in their feeding habits, and should be fed on a prepared diet of this type. Beware though, as they can sometimes damage the more delicate plants in an aquarium.

The striped anostomus can grow quite large, attaining a maximum possible length of about 20cm (8in), with its homeland being northern South America, where it occurs in faster-flowing stretches of rivers such as the Amazon and the Orinoco. There are five species forming their genus *Anostomus*, and these can be quite similar in appearance. In fact, the striped anostomus closely resembles *Anostomus ternetzi*, but it can be distinguished by the red suffusion on its fins.

A different view

Q Our local aquatic shop has some of the weirdest fish that I've ever seen. They're labelled as four-eyed fish. They look as if they're scanning the surface with part of their eyes above the water. Are they easy to keep?

A The unique arrangement of the eyes of these fish is due to the fact that they naturally live very close to the surface of the water. While half of each eye remains underwater, the upper part is directed skywards, on the search for unwary insects that form their diet, as well as potential predators that would spell danger. Four-eyed fish make unusual aquarium occupants, and are not especially difficult to keep, although since they often occur in brackish waters, the addition of a little marine salt to their quarters can be beneficial. These fish originate from parts of Central and South America, with a water temperature in the range between 22-30°C (82-86°F) suiting them well.



The eyes of four-eyed fish are effectively split into two parts, as shown by this diagram. COURTESY SGBEER.

1. Underwater retina where this part of the image forms. **2.** Lens. **3.** Air pupil. **4.** Tissue band. **5.** Iris. **6.** Underwater pupil. **7.** Air retina, detecting the image seen above the water's surface. **8.** Optic nerve, carrying these complex images to the brain, where they are interpreted.

Their aquarium must be covered, because otherwise, they may leap out of the water, ending up with potentially catastrophic consequences on the floor. Add floating plants to the aquarium so as to reduce the risk of the fish injuring themselves by jumping up.

These will provide cover fish, and they will spend much of their time lurking under this vegetation at the surface, hidden from above. The water itself should be quite shallow, typically no more than 30cm (12in) deep. Four-eyed fish may even sometimes clamber on to a rock out of the water and rest there: this is quite normal behaviour. Provide a smooth rock for this purpose.

A variety of invertebrates will be needed to keep these fish in good health, as they normally snap up such prey from the water's surface. Curly-winged flies (which are unable to fly, because of their aberrant shape of their wings) and calci-worms (which are rich in calcium) can be useful.

Crickets and locusts of suitable size that have been gut-loaded on special food, to improve their nutritional balance, can also be provided. Be sure to offer plenty of variety in the diet of these fish.

BELOW Four-eyed fish are unusual and fascinating livebearers - but they can grow relatively large, and this needs to be reflected in the size of their tank.

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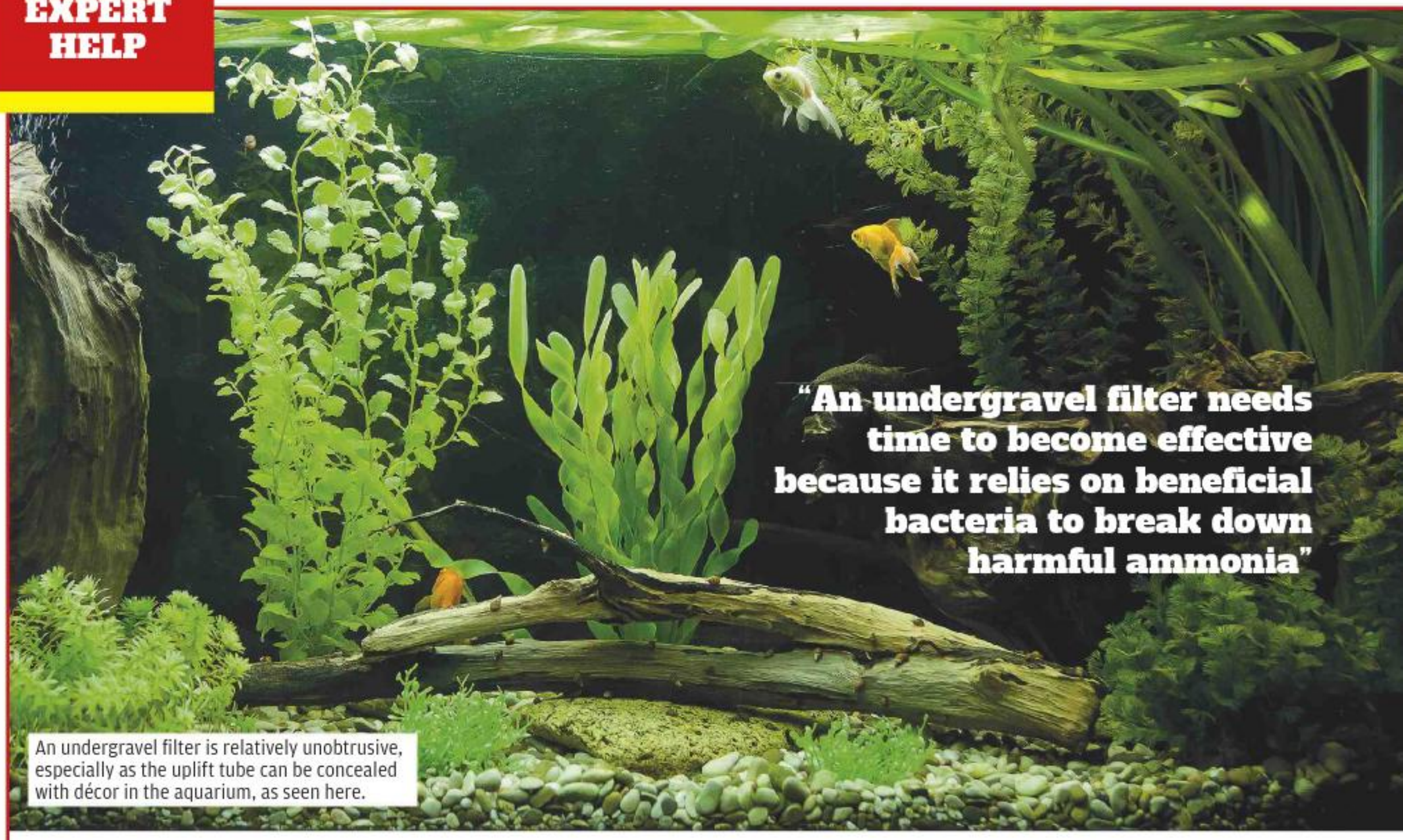


An undergravel filter is relatively unobtrusive, especially as the uplift tube can be concealed with décor in the aquarium, as seen here.

Sexing of four-eyed fish presents no problems once they are mature, since females grow about twice as large as males, reaching up to 30cm (12in) long. A very strange anatomical feature of these fish is that their external sex organs are either right or left-sided however, which places restraints on their choice of partners, because right and left must come together for the purposes of mating.

Female four-eyed fish give birth to live fry, with broods consisting of as few as three offspring, although they may breed twice a year. There is no likelihood of overlooking the young however - they are typically over 2.5cm (1in) long at birth.

Servicing needs

Q Please can you give me some advice on setting up and servicing an undergravel filter, as I'm just assembling an aquarium for the first time?

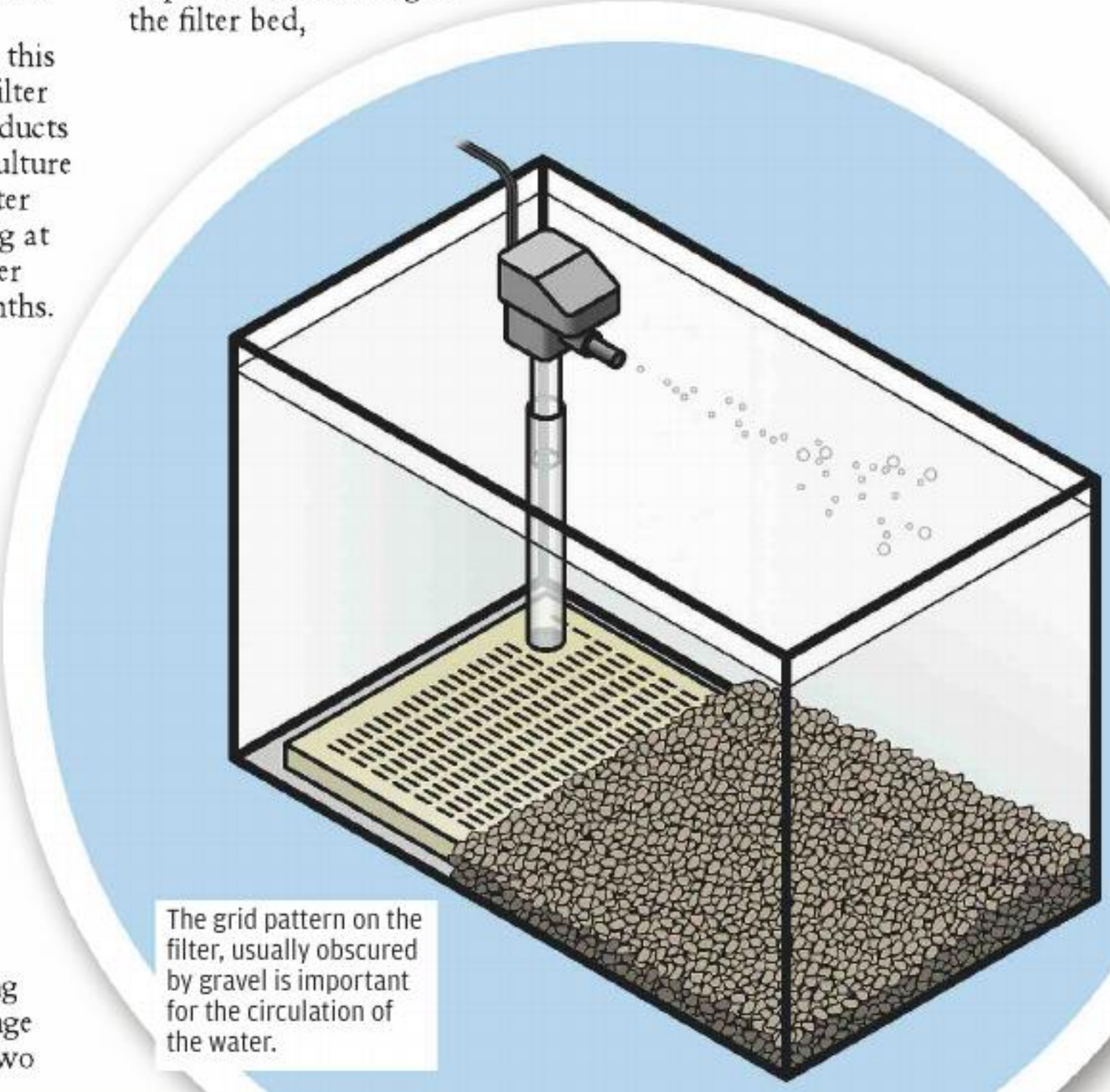
A The most important thing to bear in mind at the outset is that the undergravel filter plate needs to cover the entire floor area of the aquarium, with the gravel then being tipped in on top. The gravel particles must also be relatively coarse, as the aim is for water to flow down through this filter bed.

An undergravel filter needs time to become effective because it relies on beneficial bacteria to break down harmful ammonia via nitrite to less toxic nitrate. Their numbers must build up over the course of a number of weeks, and in a new aquarium, you can help this process by seeding the filter bed with one of the products containing a bacterial culture for this purpose. The filter should then be operating at maximum efficiency after approximately two months.

The air pump used in association with the undergravel filter must be left on constantly. This supplies the essential oxygen to the bacteria in the filter bed which they need to function effectively. With any type of filter, including an undergravel filter, it is still very important not to overfeed the fish, as uneaten food not only pollutes the water, but also causes the filter to become overloaded.

When you are carrying out a partial water change in the aquarium every two weeks or so, use one of the aquarium cleaners that serves as a siphon as well, in order to remove the mulm (waste matter) from the gravel. They are very simple to operate, and clean the gravel effectively, with minimal disturbance to the tank itself.

This should lead to improved functioning of the filter bed, and also helps directly to improve the water quality in the aquarium. Sloping the gravel slightly from the back to the front of the tank is recommended. This will allow you to see the dirt that is accumulating. Furthermore, it will then be easier to remove it from here with a siphon.



The grid pattern on the filter, usually obscured by gravel is important for the circulation of the water.

Goldfish swim in one of the waterways in the Forbidden City, in the heart of Beijing.

Gold, pearls and much more besides!

As the mist and smog of the Beijing morning cleared, it was possible to see a sight that could have been unchanged for well over a millennium, writes **David Alderton**.

Looking over the edge of a bridge in the Forbidden City – the home of China's emperors and their entourages down the centuries – it was possible to make out the sight of goldfish, swimming around in quite large numbers.

These ornamental carp, belonging to the family Cyprinidae, have played a significant part in Chinese culture, ever since their ancestors were recorded in the waterways of southern China. This was probably during the era of the ruling Tsin dynasty, around 400AD. These red-flecked fish were in fact a mutation of the Prussian carp (*Carassius auratus gibelio*) that frequented these waters and provided local people with a ready source of food.

Early development

What seems likely is that unusually coloured individuals of this type were transferred into the ponds associated with the Buddhist temples that predominated in the area. Here they would have been protected, and doubtless began to breed before long.

This would have provided an ideal start to the domestication process.

The goldfish's original ancestor. *PHOTO COURTESY GEORGE CHERNILEVSKY*

Individuals displaying red colouration would have been housed safely together, maximising the likelihood of this colour starting to replace the dull appearance of their wild ancestors.

Visitors to such temples would have been entranced by the colour of these fish, and it is easy to see how they then became popular. The subsequent Sung dynasty was a peaceful era, with pools and ponds serving as a feature of domestic architecture, and goldfish were the natural choice to bring life and movement to this type of setting.

Lasting for around 300 years, the Sung dynasty was then followed by the brief Yuan dynasty, which was a turbulent period in China's history, before the start of the Ming period. As far as animals are concerned, this era is perhaps best known today for its horses, but in fact, the ceramics of this period reflect a growing fascination with goldfish. It was during this period that goldfish started to be kept in large bowls in the home, in addition to being seen in ponds.

Buddhist temples in China still have goldfish swimming in their ponds.

ABOVE Portraits and other artistic representations help us to visualise what the early strains of goldfish looked like, compared with those of today.

Different varieties develop

Unsurprisingly, the development of the goldfish started to accelerate rapidly at this stage, as different varieties started to emerge. These were subsequently subject to careful breeding. What helped was the fact that goldfish spawn readily, and it was possible to select the offspring displaying the most striking features, and use these to pair with other goldfish of similar type.

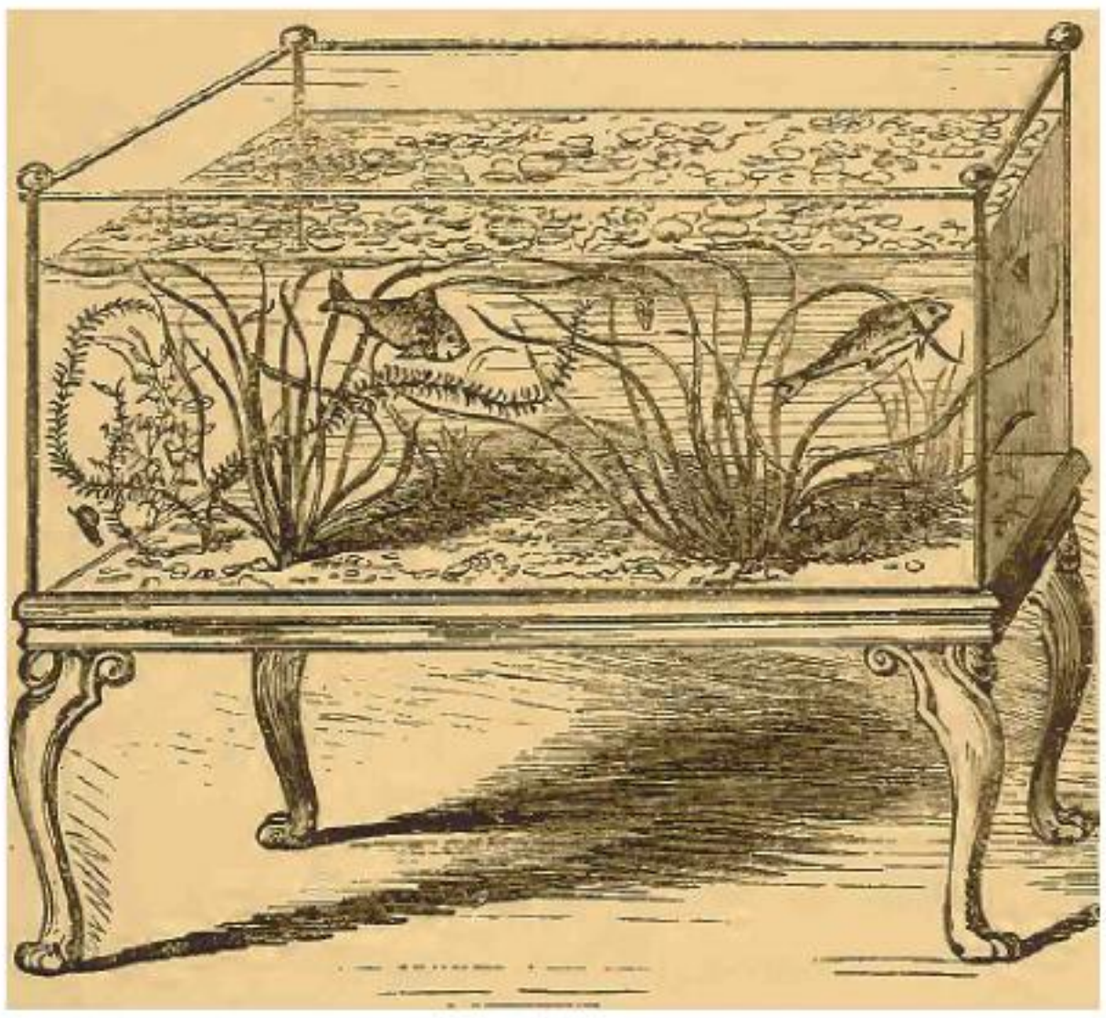
By the 1500s, some of the

CONTINUES ON THE NEXT PAGE »

A typical goldfish, which is probably similar in appearance to those first seen in Britain.

distinctive features associated with goldfish varieties today started to be seen, affecting the body shape as well as the fins. A more rotund body shape, loss of the dorsal fin and twin-tails were all features that reduced the goldfish's speed when swimming, thus making them more suitable to be kept in the home rather than a pond. Chinese artwork of this period, as reflected in scrolls and ceramics, reveals the changes that were taking place in the appearance of these fish. Unfortunately though, there has been no comprehensive study in this area, so much probably still remains to be discovered from this period. There were also some forms, according to reports, that were known but subsequently died out, and so are therefore unknown today.

BELOW A typical glass freshwater aquarium, which could be used for goldfish. This design featured in *The Book of the Aquarium and Water Cabinet*, written by Shirley Hibberd, and published in 1856. SOURCE: PD.



The move to Japan

The first goldfish to have been seen outside China reached Japan, probably during the 1500s, although no definitive records survive. It is almost certain that a number of these fish were traded over the years, and ultimately, these gave rise to varieties that are linked with Japan today.

About a century later, the first goldfish were brought to Europe, and they had become quite common by the 1750s, certainly in Britain. The statesman Horace Walpole often gave fish that had bred in the ponds on his estate to

Popular Fish Keeping Goldfish fact file

- Common goldfish can grow surprisingly large in the confines of a pond, approached 61cm (2ft) or more in length. They reach a bigger size here than in an aquarium. An oranda called Bruce Lee is the largest fancy goldfish on record, being just over 43cm (17in) overall.

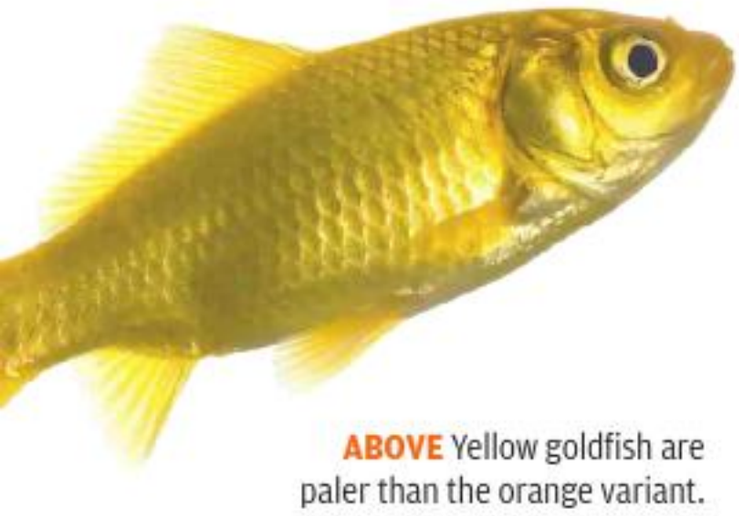
- Goldfish rank potentially as one of the longest-lived pet fish. An individual called Tish, who lived at Thirsk, North Yorkshire was 43 years old when he died in 1999. He had been given away as a prize at a funfair in 1956. There are a number of other records of goldfish surviving into their late thirties and early forties.

"Lipochromes, which are responsible for the classic golden shade, and a colour range from yellow through to red, are present just below the epidermis"

ABOVE A chocolate oranda.
BELOW A blue oranda.

his friends. The poet Thomas Grey (1716-1771) recorded the perils of cats and goldfish co-existing, in his poem *Ode on the death of a favourite cat, drowned in a tub of gold fishes*, which is thought to have related to some of Walpole's goldfish.

In 1791, goldfish were the centrepiece of a fabulous state banquet given by the Russian tsar. Yet only relatively recently did goldfish reached the USA. Some of these fish had been brought into the country in small numbers beforehand – perhaps as early as 1830. Slightly later, in 1856, when the circus pioneer and showman P.T. Barnum opened the first public aquarium in North America, he claimed that his goldfish were the earliest examples of their kind to be seen in the country.



ABOVE Yellow goldfish are paler than the orange variant.

The first official importation came from Japan though, rather than China, and these fish were given out as gifts to people living in Washington, DC. Demand expanded, to the extent that anyone who asked for a goldfish via their congressman received not just a fish, but a glass bowl to keep it in as well.

Goldfish soon became hugely popular, with the US Fisheries Commission giving away over 20,000 a year, right through until the 1890s. Unsurprisingly, they were soon being bred on a commercial scale in the USA in order to meet this demand, just as they still are today.

While some owners preferred to follow a more traditional approach, using imported, decorated Chinese tubs to accommodate goldfish, other options started to become available. Advances in technology meant that it became possible to construct aquariums for these fish, which often took pride of place in Victorian living rooms.

There was a lot of excitement surrounding aquariums – both public and private – in the second half of the 19th century.

They became increasing fashionable. Interest in goldfish grew as well, particularly because at this stage, maintaining a tropical tank in the absence of a reliable electrical supply was fraught with difficulty – not to mention a degree of danger too.

How the goldfish gets its colours

There are basically two protective layers surrounding a goldfish's body. There is the outer epidermis plus an inner dermal layer, and sandwiched between these are the colour pigments that create the fish's colour.

Lipochromes, which are responsible for the classic golden shade, and a colour range from yellow through to red, are present just below the epidermis. But the

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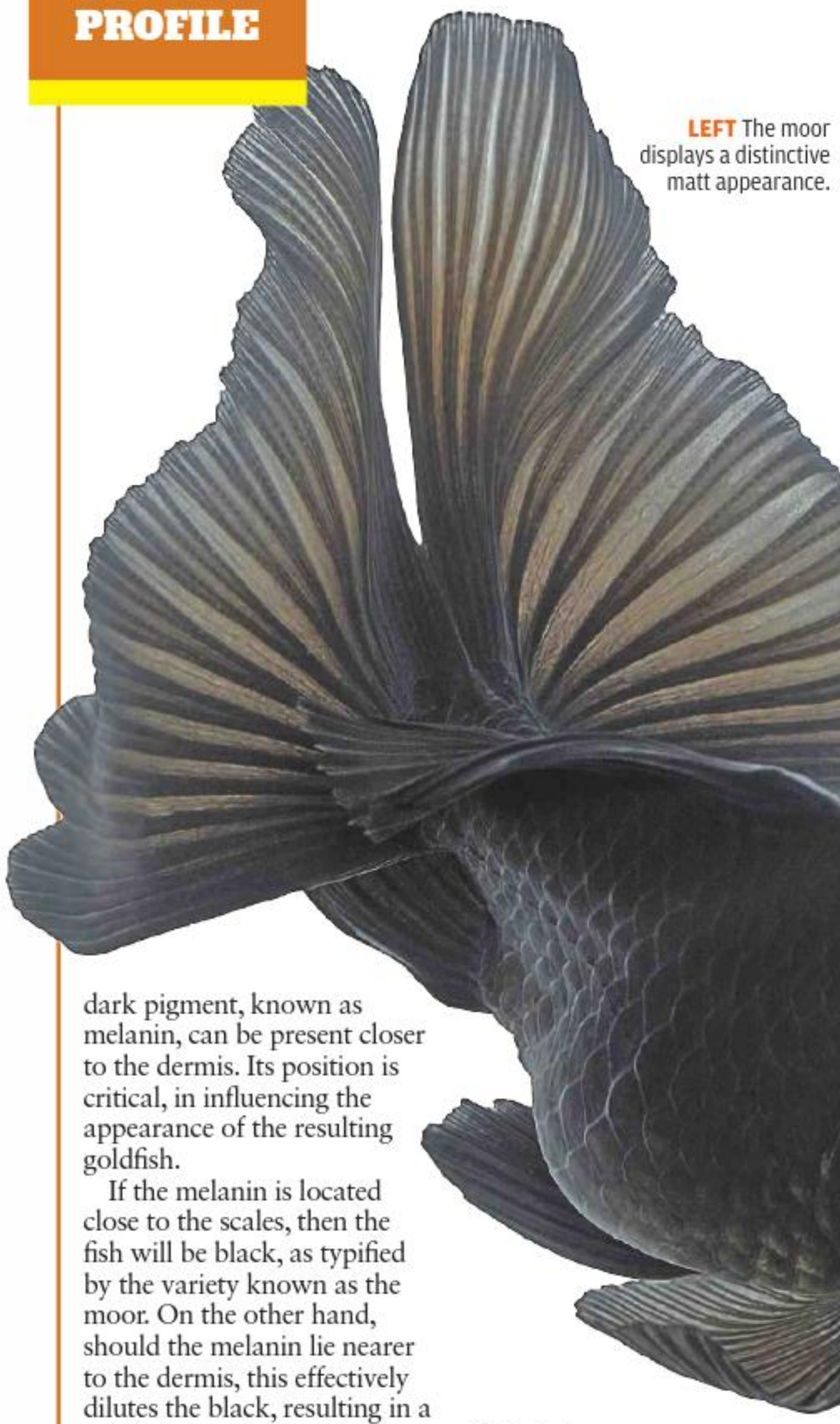

LEFT The moor displays a distinctive matt appearance.

dark pigment, known as melanin, can be present closer to the dermis. Its position is critical, in influencing the appearance of the resulting goldfish.

If the melanin is located close to the scales, then the fish will be black, as typified by the variety known as the moor. On the other hand, should the melanin lie nearer to the dermis, this effectively dilutes the black, resulting in a goldfish described as blue.

In the absence of melanin, typical bright colouration results, but if both lipochromes and melanin are present, overlaying each other, then the goldfish will have what is described as chocolate colouration, with a brownish shade.

In the absence of both types of pigment, then the fish will have a whitish colouration. Markings of this type tend to quite commonplace, although totally white individuals are seen on occasions as well.

Another factor impacts on the appearance of goldfish. This is the presence – or absence – of cells known as iridocytes within the dermis. As their name suggests, these serve to give the fish a shiny appearance. In some cases though, the number of iridiocytes is reduced, and this creates a mother-of-pearl effect, described as nacreous. Such goldfish are less iridescent than normal.

If the iridiocytes are totally missing though, then the goldfish's body has a matt appearance. This is a feature that characterises the moor.

The varieties

It has been estimated that today, there are well over 120 different varieties of goldfish, each with individual characteristics – and as many as 300 in China according to some reports.

There are dedicated breeders who seek to maintain the distinctive appearance of such fish that have now existed sometimes for centuries.

While in China engaging in my goldfish quest, I headed down a dusty road to a rather uninspiring concrete building, only to see the most fantastic range of fancy goldfish on view inside. Huge orandas, of a size that you never normally see here in the UK were just one of my lasting memories.

Although unfortunately, it wasn't possible to converse with the shop staff, it appears that they took great pride in breeding these fish, using rigorous selection to choose the best individuals and so maintain the bloodline. It stuck me – although perhaps mistakenly – that these fish were viewed as part of the country's cultural heritage, and they were cherished accordingly.

British varieties

Here in the UK, two distinctive goldfish varieties have been developed – beginning with the London shubunkin during the 1920s. These fish have distinctive blue speckling, which is variable in its depth of colouration, offset

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"It appears that they took great pride in breeding these fish, using rigorous selection to choose the best individuals"

Mottling is a characteristic feature of shubunkins.

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"One of the reasons that goldfish have remained so popular is the fact that they are colourful and easy to care for"

against red and white areas, with a distinctive long, flowing caudal (tail) fin.

Later in 1934, the Bristol Aquarist Society in the west of England combined the London shubunkin with the American form, resulting in the variety now known as the Bristol shubunkin. This can be distinguished at a glance from the London form, thanks to its rounded tail.

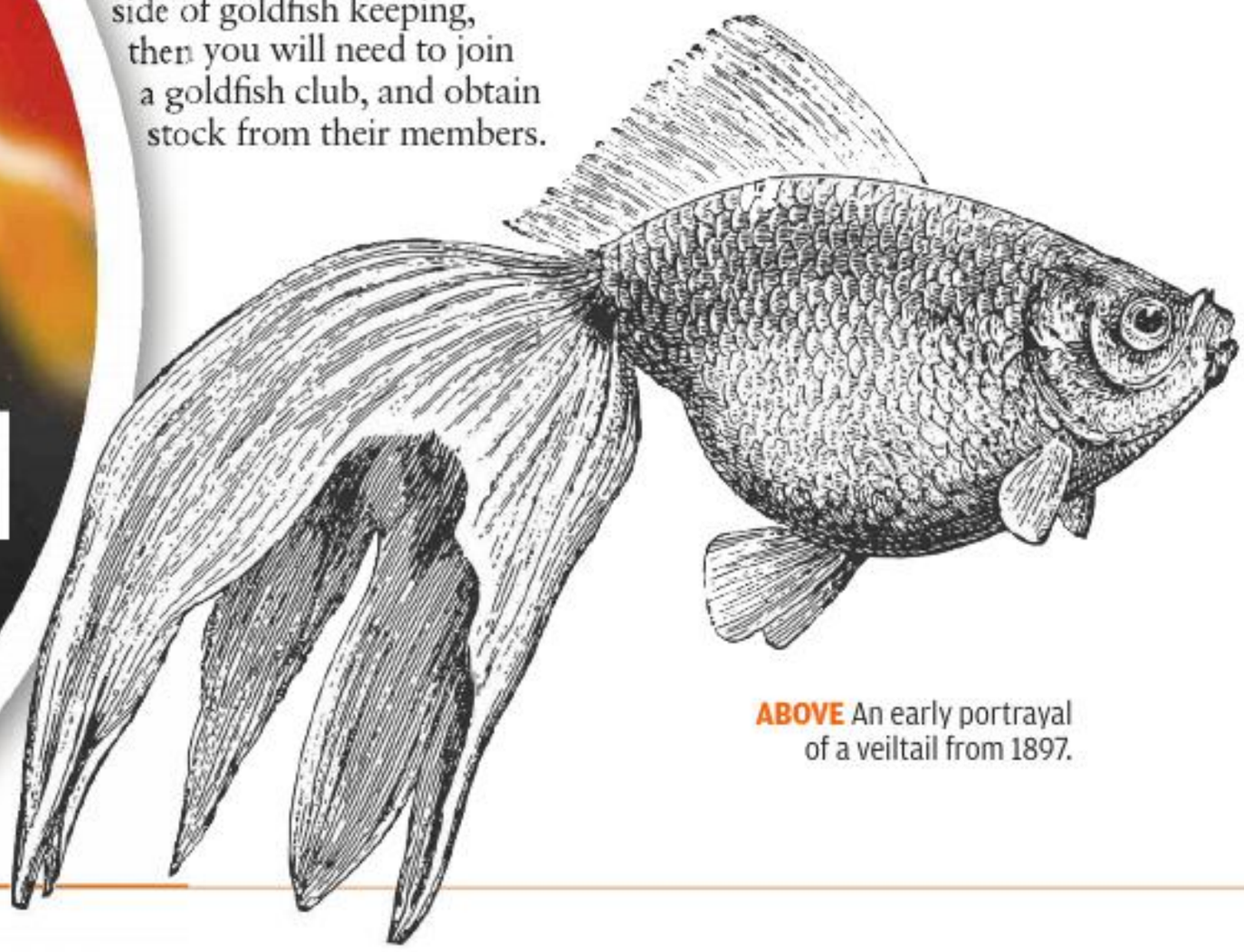
Starting out with goldfish

When you go to buy a goldfish today, the range of varieties available is now greater than it used to be in the past. Some that were virtually unknown outside their homeland, such as the pearlscale, which was originally bred in the Chinese province of Kwangtung, are now readily available. Yet it is important to bear in mind that these fish are not leading examples of their type. If you want such fish, and are interested in the exhibition side of goldfish keeping, then you will need to join a goldfish club, and obtain stock from their members.

It is rather like the difference between having a Crufts champion and a mutt – but both can bring you great pleasure!

One of the reasons that goldfish have remained so popular – still ranking as the most widely kept pet fish – is the fact that they are colourful and easy to care for, even if you have not kept fish before. They are ideal for children too, as a first pet, and they can be surprisingly long lived.

Veiltails are very elegant goldfish.



ABOVE An early portrayal of a veiltail from 1897.

A lionhead with a well-developed hood.

The pearlscale is a very distinctive variety.

Split into two groups

It is worth bearing in mind that goldfish can be divided into one of two groups. There are long-bodied forms, such as the shubunkins, or indeed the comet, which is a striking red and white variant with an elongated tail, that will thrive in outdoors ponds throughout the year, alongside the common goldfish.

Fantails differ by having a caudal fin that is double and is equivalent to about a third of the fish's body length. But it is well supported, and does not droop. This sets it apart from the veiltail, where again the fin is enlarged, but in this case, the caudal fin trails down behind the body. The body shape of these goldfish is slightly rounded rather than elongated in profile.

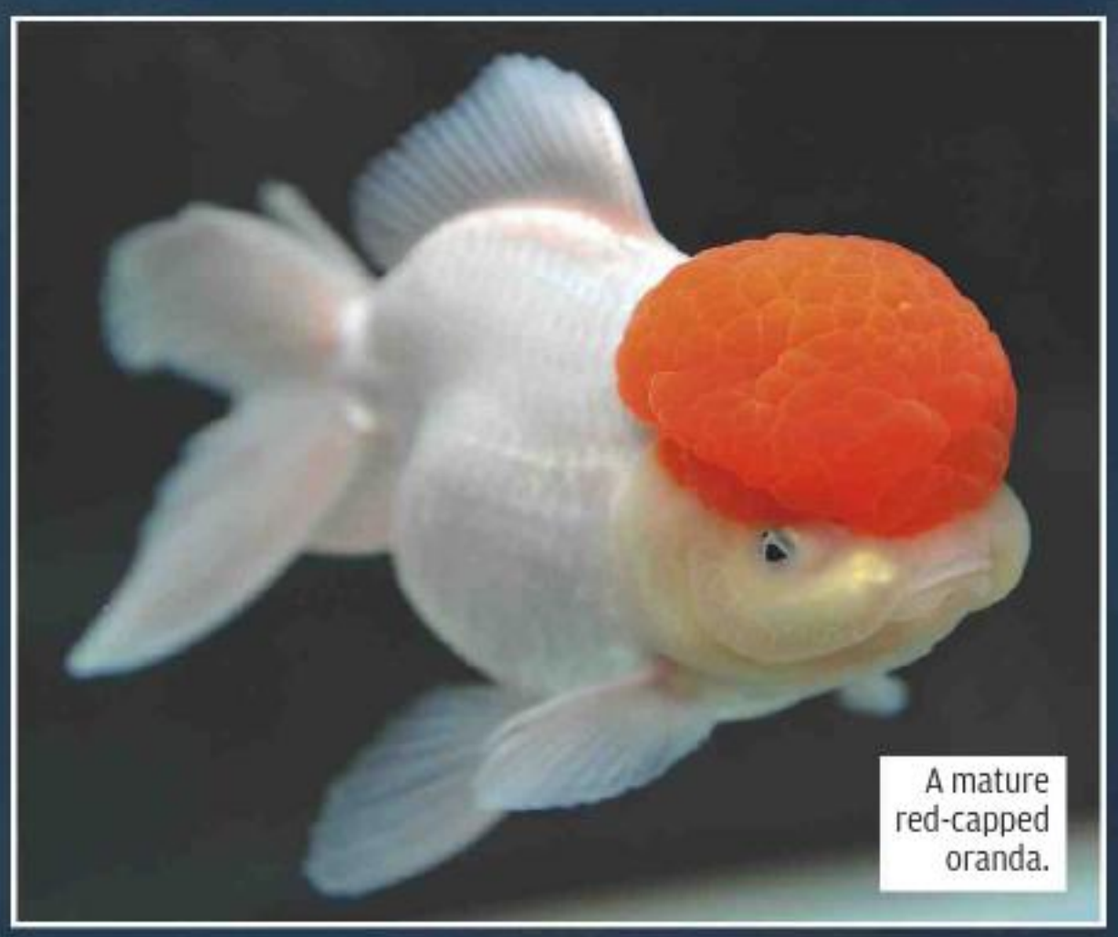
The veiltail's elaborate fins mean that these can be easily damaged, and will also suffer and become ragged if water conditions are poor. Both this variety and the fantail are better suited to being kept in aquariums, where their beauty can be appreciated, although they tend to grow to a larger size than many of the more ornate fancy varieties. Always choose a relatively tall and spacious aquarium therefore, as this helps to emphasise the flowing shape of their fins as they swim.

Other fancy goldfish

Such goldfish display considerable variation in their overall appearance, usually having a fairly corpulent body and a less streamlined shape overall, compared with the common goldfish. They are also not hardy, and so must be housed in an aquarium.

Moor – this variety is sometimes known as the black moor, being defined by its matt black colouration. These goldfish have a double caudal fin, which will be particularly apparent when they are viewed from above.

Pearlscale – distinguished partly by its fairly dumpy body shape, but more significantly by the white, pearl-like spots evident on the sides of its body. These do not extend to the head. Variegated red and white forms of the pearlscale are common.



A mature red-capped oranda.

Lionhead – a characteristic swelling, known as the hood, develops on the head of these goldfish as they mature. This may take four years or so reach its full extent, and is said to resemble the mane of a lion, extending down below the level of the eyes to the gill plates. These fish prefer reasonably cool, well-oxygenated water. The back should be smoothly curved, in the absence of a dorsal fin, ending in a double caudal fin.

Oranda – a variety that is closely-related to the lionhead, but easily distinguished by the presence of a dorsal fin on the back. These goldfish can be bred in a variety of colours, with chocolate and blue examples now being readily available, but the favoured form is the red-capped oranda whose bright red cap is in stark contrast to its white body.

Ranchu – this is the Japanese counterpart of the lionhead, but can be distinguished by its shorter body and the increased curvature of its back. The caudal fin is quite small and should be symmetrical.

ABOVE Ranchu - a goldfish developed in Japan.

Ryukin – another goldfish of Japanese origins, it can be easily distinguished by the very distinctive hump which raises the dorsal fin along the back well over the level of the head. These goldfish are named after Japan's Ryukyu Islands where

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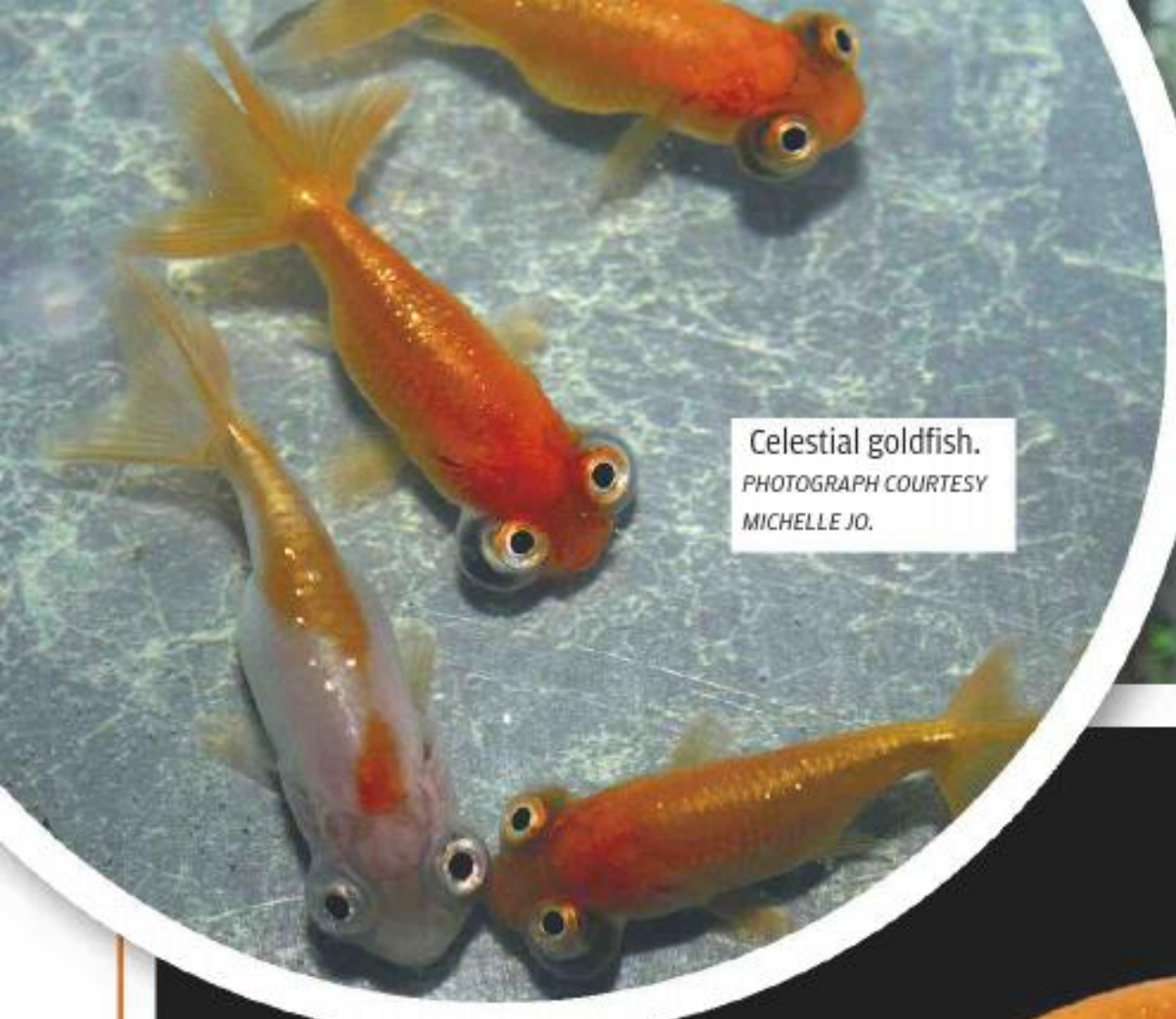


Celestial goldfish.
PHOTOGRAPH COURTESY MICHELLE JO.

Goldfish are quite social by nature, although they are not strictly defined as a shoaling fish. Aim to keep more than one together therefore, if you have space available.

The bubble eye variety is easily recognised. Be sure not to include any sharp rocks that could damage their eye sacs. Obstructions should be kept to a minimum for these and celestials, because their vision is restricted.

ABOVE A red and white Ryukin.

they are said to have been first bred from goldfish brought from China.

Bubble eye – this is a very unusual variety, thanks to the presence of jelly-filled sacs under each eye. There is no dorsal fin, and the back should ideally be smooth. These goldfish have been bred in a wide range of colours. The aim is for the sacs under the eyes to be of the same size and shape, but this is not always the case.

Celestial goldfish – in the case of these fish, their eyes have shifted from the side of the face to a more horizontal position, so they look combinations are often seen.

Butterfly – named after the appearance of its caudal fins, which look like the wings of a butterfly when viewed from above, this breed is also characterised by its telescope eyes, projecting out from the face. One of the most popular forms in this case is the so-called panda, which is predominantly black and white, but often shows some slight trace of pale lemon markings too.

A goldfish aquarium

I would recommend buying a relatively large tank at the outset, so that you will not have the unnecessary expense of replacing the original aquarium once your fish grow bigger. In addition, although fancy goldfish may not be the most powerful fish in terms of their swimming ability, they do have a rather appealing style that is good to watch.

In terms of equipment, there is no need for a heaterstat, but it can be worthwhile investing in a basic digital thermometer, so you can keep a check on the water temperature. An undergravel filter will be useful, although bear in mind that goldfish will tend to excavate the gravel, in search of any edible items. A power filter is therefore a good idea, serving to remove particles of dirt in suspension, and helping to keep the water cleaner.

When it comes to planting, there is often little point trying to devise a complex planting plan, because goldfish will be inclined to dig up any plants directly, or uproot them with their swimming action. Providing a reasonably open space in the main area of the tank is therefore to be recommended.

If you want to try some coldwater plants, set them around the back and sides of the tank, as this should give them the best chance of becoming established. Floating plants, in the guise of duckweed can be incorporated though, and the fish may choose to snack on this at times, adding variety to their diet.

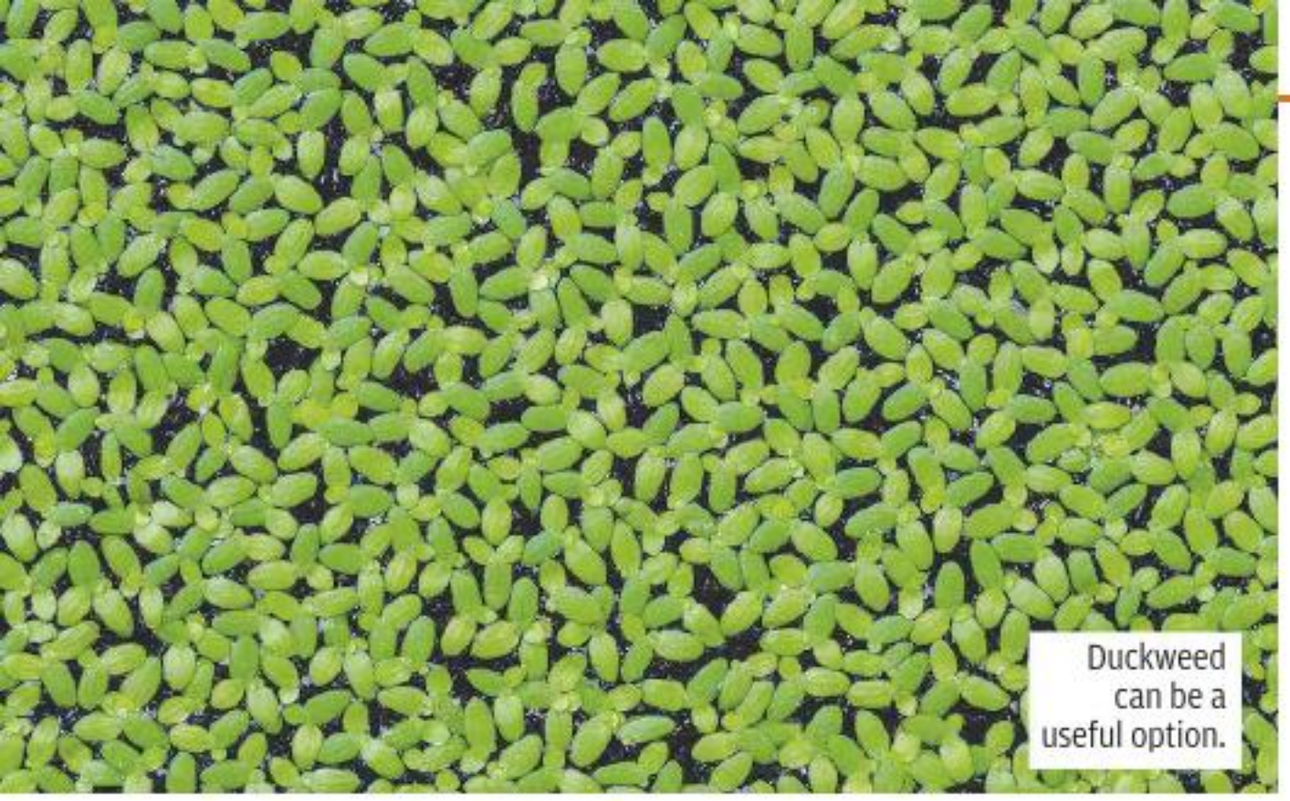
If the duckweed grows too profusely under the aquarium lights, simply scoop some of it out with a net. Otherwise, should it form a very dense cover, then any live plants in the main body of water could start to die back, being deprived of light.

Do provide some cover in the form of a suitable retreat in the aquarium where the goldfish can hide. You can find a good choice at your local aquatic shop. Do not forget to buy a water conditioner either, which will neutralise chlorine-based chemicals in tap water. This should be used whenever you add fresh water to the aquarium.

Site the tank in a position when it will be easy to see the occupants, and be sure that it

DID YOU KNOW?

Goldfish are sometimes confused with another cyprinid, in the guise of koi, but they can be easily told part on the basis that goldfish do not have barbels around their mouth, as this close-up photo reveals.



Duckweed can be a useful option.

ABOVE White spots indicating breeding condition are very restricted in male goldfish. Do not confuse these with the parasitic ailment known as white spot.

ABOVE Goldfish are easy to feed, with a variety of prepared foods available for them. Safe livefoods can also be beneficial.

is not located either directly in front of or near to a window, where the sun could raise the water temperature rapidly on a warm day to a fatal level for the goldfish. You are also likely to find that the tank will be blighted with algae in this position.

Feeding

Catering for goldfish is very straightforward, with a variety of flake and pelleted food of various types available. There are special foods for some varieties such as lionheads and orandas as well, devised with the aim of meeting the specific requirements of these particular fish.

In the case of fancy goldfish though, and especially Moors, they can be vulnerable to a disorder of the swim bladder, which causes them to have difficulty in swimming and maintaining their buoyancy correctly.

It can help to prevent this problem if you offer them pellets that sink rapidly, rather than flake food that floats at the surface. This is because they will otherwise inevitably gulp down air as they ingest their food.

Goldfish in terms of their ancestry are bottom feeders anyway, and are quite happy seeking food in this part of the aquarium. As always, feed them a little and often, taking care not to offer more than they will eat within a few minutes.

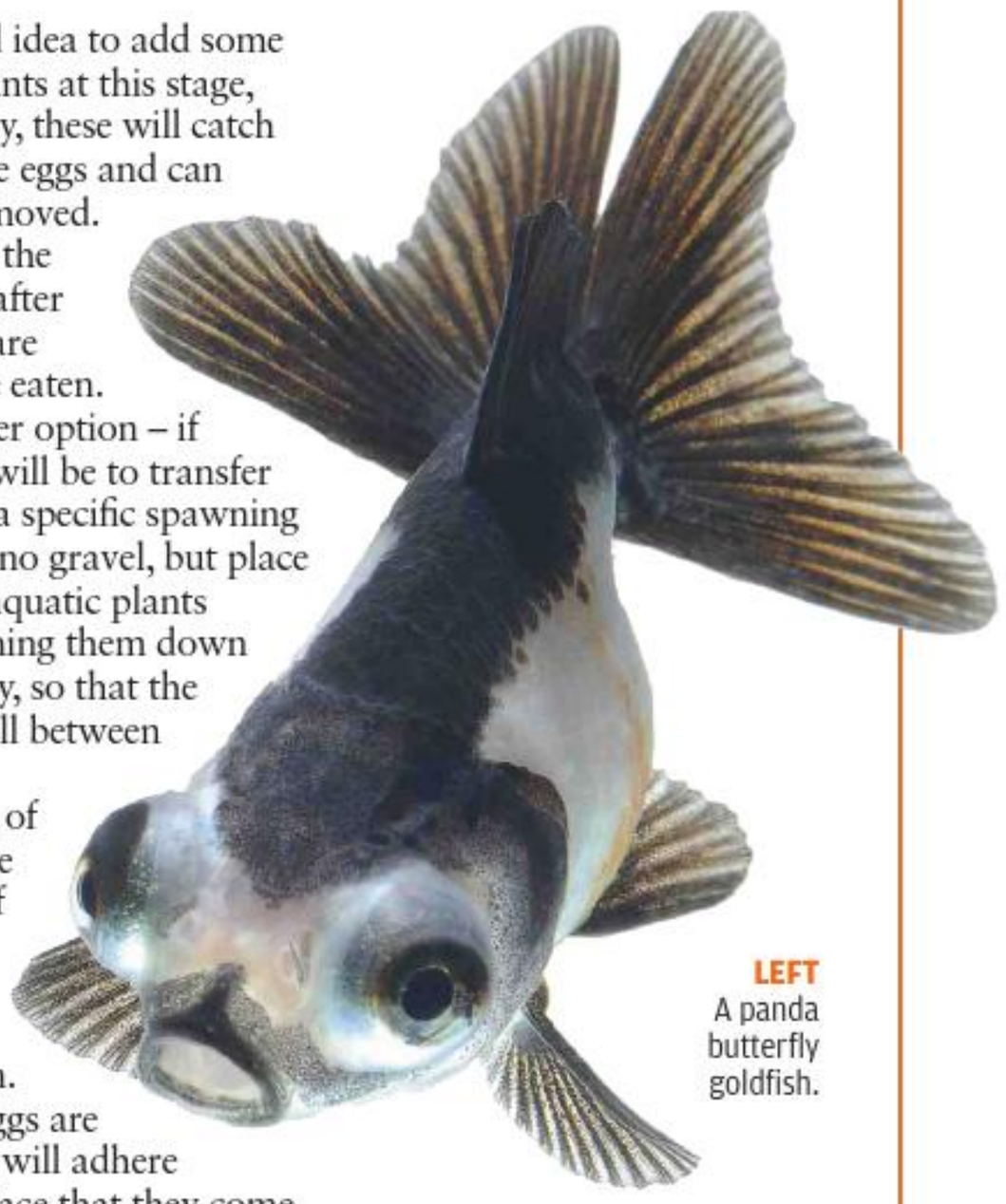
Breeding

It is quite possible to breed goldfish in a home aquarium, with sexing becoming possible as they come into breeding condition. This is most likely to happen even in aquarium surroundings during the spring. Male fish can be identified then by the presence of white pimples on their gill covers, and these may also be evident on the leading edges of the fins as well.

The female will start to swell with eggs, and for a period, the male will pursue his mate determinedly as the time for spawning approaches.

It is a good idea to add some aquatic plants at this stage, as hopefully, these will catch some of the eggs and can then be removed. Any left in the aquarium after spawning are likely to be eaten.

The better option – if possible – will be to transfer the fish to a specific spawning tank, with no gravel, but place a layer of aquatic plants here, weighing them down in necessary, so that the eggs can fall between the leaves, largely out of reach of the adult fish if you are not there when they spawn. Goldfish eggs are sticky, and will adhere to any surface that they come into contact with, which may include the sides of the tank.



LEFT A panda butterfly goldfish.

Hatching indoors is likely to take about 4-5 days, being directly influenced by the water temperature. The fry will be inert at first, as they absorb the remains of their yolk sacs, before becoming free-swimming. This is the stage at which they begin looking for food.

The young goldfish can be reared quite easily on commercially available fry foods, and then powdered flake can be offered, along with small water creatures. As they grow, you will see that they are olive-brown in colour. It will take time for them to develop their individual colouring, and not all the goldfish will start to change colour at the same time.

The earliest that you are likely to notice any change will be around two months old, and in some cases, it can take a year or more for them to become more colourful. In a few cases though, some never alter in colour. The usual tendency is for the black areas to transform over different parts of the body, with the more brightly coloured areas then coalescing over time, so the dark pigment largely disappears.

"One of the most popular forms in this case is the so-called panda"

Further information

A complete list of goldfish organisations worldwide – including those in the UK – with their contact details can be found at www.goldfishsociety.org/ww_organizations.html

Business profile

Photomax at the Goldfish Bowl, Oxford.

An aquarium will bring pleasure and enjoyment to the whole family and makes a perfect centrepiece for your home. But whether you're new to the hobby or a veteran fish keeper, the boundaries of a fish tank do not stop at its four glass panes. Obtaining the right advice and equipment is vital, and the Goldfish Bowl in Oxford is one of the most respected aquatic outlets in the country.

This large independent retailer employs a team of staff led by Peter Mundy, with over 100 years of fish keeping experience between them. Passionate about the hobby, they will listen to all your requirements and will be happy to help every step of the way, so that you can create your dream tank.

Award-winning knowledge and professionalism

The Goldfish Bowl stocks dry goods from most of the major suppliers such as Mars Fishcare, Seachem, Tetra, Eheim, AquaPacific, Juwel, Tropical Marine Centre and many more. This allows the customer to be able to select from the largest possible range of products at all times.

The shop also has the distinction of being a Mars Fishcare Gold Dealer, one of the select few outlets to hold this award in the country. Most recently, The Goldfish Bowl has also become one of just fifteen shops in the UK to achieve Seachem platinum dealer status, which is the pinnacle of Seachem excellence.

Aside from helping you to make the right choices and set everything up correctly in the first instance, you can be sure that the livestock you buy from The Goldfish Bowl has been fully acclimatised for the home aquarium. The business has over 100 quarantine tanks set aside specifically for this purpose.

"At The Goldfish Bowl, the fundamental belief is that to keep good fish, you must have good water quality. That is why we offer free water tests as well as free reverse osmosis water - up to 50 litres or 10 gallons," explains Peter Mundy "All of our customers are also given a water test chart where they can record all test results to help them manage their water quality."

Fish and invertebrates

In its livestock section, the Goldfish Bowl always has a large variety of fancy goldfish from China and Thailand. On the tropical side, customers have a very wide choice too, ranging from common species such as the neon tetra through to real rarities such as the geryi piranha; there is also a stunning selection of male Siamese bettas available. Within the marine section is an amazing array of fascinating marine fish, such as moray eels, blue-spotted stingrays and of course, the ever-popular clownfish.

"Our latest addition is a new invertebrate and cultivated seahorse room. The display attempts to mimic an underwater wonderland with the inverts delicately positioned to its best advantage," explains Peter. "The twenty tanks are home to soft corals, mushroom on rock, zoanthids, anemones, feather dusters, shrimps, crabs, urchins, starfish and many more. The new invertebrate room also has information about all the inhabitants to educate children, who represent tomorrow's fish keepers."

The shop opens its doors to educational visits from local school pupils, where they can learn about sea life and have a chance to feed the fish. In fact, the Goldfish Bowl was mentioned in a guide to Oxford's hidden gems as a 'water wonderland' to charm the children.

Aquascaping with plants?

If plants are your passion, you will typically find over sixty species originating from three different continents available. The contemporary styling here makes shopping for your perfect plant much easier. With five tanks, all over 3m (10ft) long, the custom-built display is fitted with under-gravel heating cables to help the movement of essential bacteria through the layer of DUPONIT-mix.

Above that is a layer of quartz gravel - each particle only measures 2mm (0.07in) - encouraging maximum plant growth. Carbon dioxide (CO_2) is injected into the water at the required levels, with everything being controlled by a mini computer to ensure that optimum levels are maintained.

Water movement is even regulated to create a slow flow rate, so as to prevent the build up of excessive oxygen that can be harmful to aquatic plants. The labels on the tanks provide specific information about each plant, including its requirements and growth rate, helping you to make the right decision for your aquarium.

Contact details

Where: The Goldfish Bowl, 118 - 122 Magdalen Road, Oxford, OX4 1RQ
Opening times: Monday - Saturday: 10am - 5.30pm; Sunday: 11am - 5pm
Telephone: 01865 241825
E-contacts: www.thegoldfishbowl.co.uk; e-mail: barryallday@utdsl.com
Photomax Aquarium Picture Library: website: www.photomax.org.uk

Getting there

The Goldfish Bowl lies on the south-eastern side of Oxford, and is easily reached from the A4142 Eastern By-pass, by heading along the B480 Cowley Road. Magdalen Road is a turning on the left, off the Cowley Road. Alternatively, it can be reached directly by following Rose Hill and then the A4158 Iffley Road, again from the Eastern By-Pass, and turning right into Magdalen Road. The shop is approximately 5km (3ml) from Oxford Station.

Photographic outlet

In conjunction with Barry Allday, Max Gibbs is a partner at The Goldfish Bowl. He founded this aquatic fish shop in the 1950s and was also the first importer of marine fish from the Philippines into the UK. A keen photographer too, Max decided to combine his two hobbies and created the Photomax Aquarium Picture Library, one of the world's largest stock image banks for aquarium fish and associated subjects. The library is constantly being updated as Max travels the world to photograph unusual species.

Part of the aquatic plant range.

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Young ryukin goldfish. Assessing fish from all angles when judging is important

Showing through the judge's eyes

There's keen interest not just in keeping and breeding fish of course, but also in exhibiting them. **Susie Kearley** recently spoke with one of the country's leading fish judges, to discover what is involved in this area of the hobby.

SUSIE KEARLEY
Aquarium writer

Colin Pannell lives in Hastings. He is on the Federation of British Aquatic Society's Judges and Standards Committee, and is currently the secretary for the committee, as well as judging at many of the society's fish shows and competitions. He is also treasurer for the main committee, while his wife, Joan acts as the secretary. Here Colin considers fish keeping from a judge's perspective, and talks about the hobby that has held his attention for almost fifty years.

SK: How long have you been involved in fish keeping?

Colin: I began back in 1966, when I started out with guppies, platies and swordtails. We then moved to Hastings three years later, and I spotted an advert for the Hastings & St. Leonards Fish Club. It sounded like a nice idea to share the hobby with other enthusiasts, so I joined and started to learn about other varieties of fish. At the meetings, they had something called 'Table Shows', where people would bring their fish along to be shown and judged by local judges. I decided to exhibit myself and that's how I got stated in showing.

After taking part in Table Shows for about three years, I was gaining confidence and starting to win regularly, so I tried my hand at Open Shows. These events were open to many more competitors, which obviously made them more challenging and difficult to win. The number of fish in each class was typically around 20 – sometimes even more. I was used to exhibiting in Table Shows where my exhibit was only up against two or three other fish. So Open Shows represented a much more competitive environment.

"I had to sit an exam. It consisted of practical judging of about 20 fish and a written paper of around 50 questions about judging"

Training

SK: How did you make the transition from exhibitor to judge?

Colin: While I was taking part in the shows, I was learning more and more about keeping other varieties of fish and about the identification of obscure varieties. Then in the mid-1970s, I was invited to attend a training course for judges run by the local Area Panel of the Federation of British Aquatic Societies. The course lasted about three months, running on most Sunday afternoons.

ABOVE Livebearers including swordtails were the first group of fish that Colin kept.

Angelfish and young. The likelihood of being able to breed your fish today is greater than ever, thanks to technology now available.

Condition, colour and size of the fish are all important features for judges to consider.

ABOVE A range of trophies will be awarded at larger shows. These are for a specialist show, for guppy enthusiasts. *PHOTO COPYRIGHT RALF LOCH*

LEFT Some shows are specialist shows, catering for one type of fish, as at this event organised by www.fancyguppies.co.uk. *PHOTO COPYRIGHT RALPH LOCKE.*

I learnt the finer details of judging and all the procedures that had to be observed as a judge. At the end of the course, I had to sit an exam. It consisted of practical judging of about 20 fish and a written paper of around 50 questions about judging. I passed the tests and then had to wait for confirmation from the Federation of British Aquatic Societies before I could become a 'C' class judge. Being awarded this qualifying status enabled me to judge at Table Shows and inter-club shows.

I continued to learn more and gather information on different types of fish. After two years, I was eligible to take another test that would upgrade my status as a judge. I was successful and so became a 'B' class judge, meaning that I could place some awards at Open Shows.

It was three years later when I decided to embark upon a further series of tests that would enable me to judge Championship Classes at Open Shows or larger exhibitions. The tests had to be taken at an Open Show and they consisted of a practical test and one written paper. I was delighted that I passed, and my status as a judge was upgraded again.

In 1983, I joined the Judges and Standards Committee. I've been a member ever since, and I am the current secretary for the committee. I'm very interested in the identification of any new species that come our way. Since the advent of the internet and digital photography, it has become much easier to be able to overcome identity issues surrounding unusual and problematic fish.

Each year, I produce one of the Federation's books. It is the size guide, sent free of charge to judges but it can be obtained at a small cost early in the showing season from our merchandising officer. It is also put onto our website later in the year. I rely on other judges to send me information regarding new fish to be added to the list, or any size adjustments, either up or down, based on any of the fish that they have seen during the year.

Changes in the hobby

SK: How has fish keeping and showing changed over the past 40 years or so that you've been involved in the hobby?

Colin: The hobby has changed tremendously since I first started keeping fish. The varieties of fish now available are mind-blowing. They are being bred in many countries of the world and with rapid air travel, they normally arrive in good health without any problems, thanks to careful packing as well.

The quality of the available equipment has improved in leaps and bounds too, and although the cost has probably risen, I believe that it represents very good value for money. Not only does it make it easier to keep the fish in good health, but it also means that the chances of breeding them are increased too.

One of the main improvements in judging has been the introduction of the refraction rule. This allows a judge to measure the size of a fish in a tank accurately. A judge needs to be able to carry out this task so that a

TURN OVER FOR MORE ABOUT FISH SHOWS »

Judging in progress. Set criteria are laid down in each case. *PHOTO COPYRIGHT RALF LOCH.*

Judges will assess a variety of classes, and accurate recording is vital. *PHOTO COPYRIGHT RALF LOCH.*

Question and answer session at the 2012 Fancy Guppy UK International Show.

size mark can be awarded. The fish's pointing is worked out on a logarithmic scale whereby a ½ size fish will get 3 for size, and a ¾ size fish will get 6 for size. A full size fish will get 10 for size, which is the maximum size mark awarded. The measuring rule works on a reflection of the rule over the fish whilst in the tank.

Show organisation

SK: What else do you look for when you're judging?

Colin: A fish at an Open Show will be placed in a plain tank without plants or gravel and the tank must be large enough for the fish to be comfortable inside it. All fish are placed in their respective classes, such as barbs, cichlids, characins, and loaches and the like, based on the show schedule.

There are many other categories for judging:

In the 'Body' class, judges assess the body of the fish for the correct shape for that species. We check to ensure there is no damage and there are also no deformities.

In the 'Colour' class, the judge assesses the overall colour of the fish conforming to the standard colour of that particular variety.

In the 'Fins' class, we look at whether the fish has all its fins and check that there is no damage on them.

In the 'Condition & Deportment' class, the fish is assessed as to whether it looks comfortable in its tank and we also look to check that there are no signs of any disease.

In the 'Presentation' category, a judge looks at the overall look of the exhibit including water clarity and condition of the tank.

The points are then allocated as follows:

- 10 points for Size.
- 10 points for Presentation.
- 20 points for Body.
- 20 points for Colour.
- 20 points for Fins.
- 20 points for Condition & Deportment.

All the rules are laid down by the Federation of British Aquatic Societies. (You can find these in booklet no. 5, entitled *Constitution and Show Rules*). Those judging rely on years of experience, as well as referring to books and websites for the purposes of fish identification. Judges at Open Shows usually have a choice of which class they would like to judge at any particular show, but they normally try to judge all the classes over the course of the showing season.

A winning fish needs to be as near to full size as possible, undamaged, and in a clean tank with clear water. There used to be very large exhibitions where Tableaux were staged – a Tableau was a large themed

Corydoras like this three-striped (*C. trilineatus*) are one of Colin's favourite's groups.

RIGHT Special colour foods are available for a wide range of species today, catering for cichlids for example, like this oscar. They really can make a difference too.

box with tanks fitted into the walls and fish were exhibited inside the tanks, but you do not see them these days.

Personal preferences

SK: With regards to feeding, do you feel it's worth fish keepers spending extra on leading brand fish foods, or are they all basically the same?

Colin: Personally, I prefer to feed my fish on a good quality branded food from a reputable supplier.

SK: Does the food provided to fish affect the colour vibrancy of the fish for shows?

Colin: Some foods incorporate colour-enhancers in them and you can tell if a fish has been fed this colour-enhancing food, as their colours are particularly rich and bright. The fish's colour reverts back to its natural shade if it is switched back on to ordinary fish food.

SK: Do you have a favourite breed or variety of fish?

Colin: I have always had a liking for corydoras catfish. Their centre of distribution is the Amazon region of South America. I have kept these fish throughout my many years of fish keeping. They are only small fish, growing up to approximately 8cm (3in) long, but I find they have a character of their own and they are very active in a tank, living well together in groups.

SK: What tips do you have for people interested in showing their fish?

Colin: If you wish to show fish, I would suggest that you join your local society and learn from people who show regularly. This is the best way to gain experience and get to know what good show fish are like. Not all fish are suitable for showing, so you will need to talk to regular exhibitors. Although showing is obviously competitive, people are friendly and keen to pass on tips to newcomers.

An exciting event

SK: Do you have anything else you'd like to share with readers?

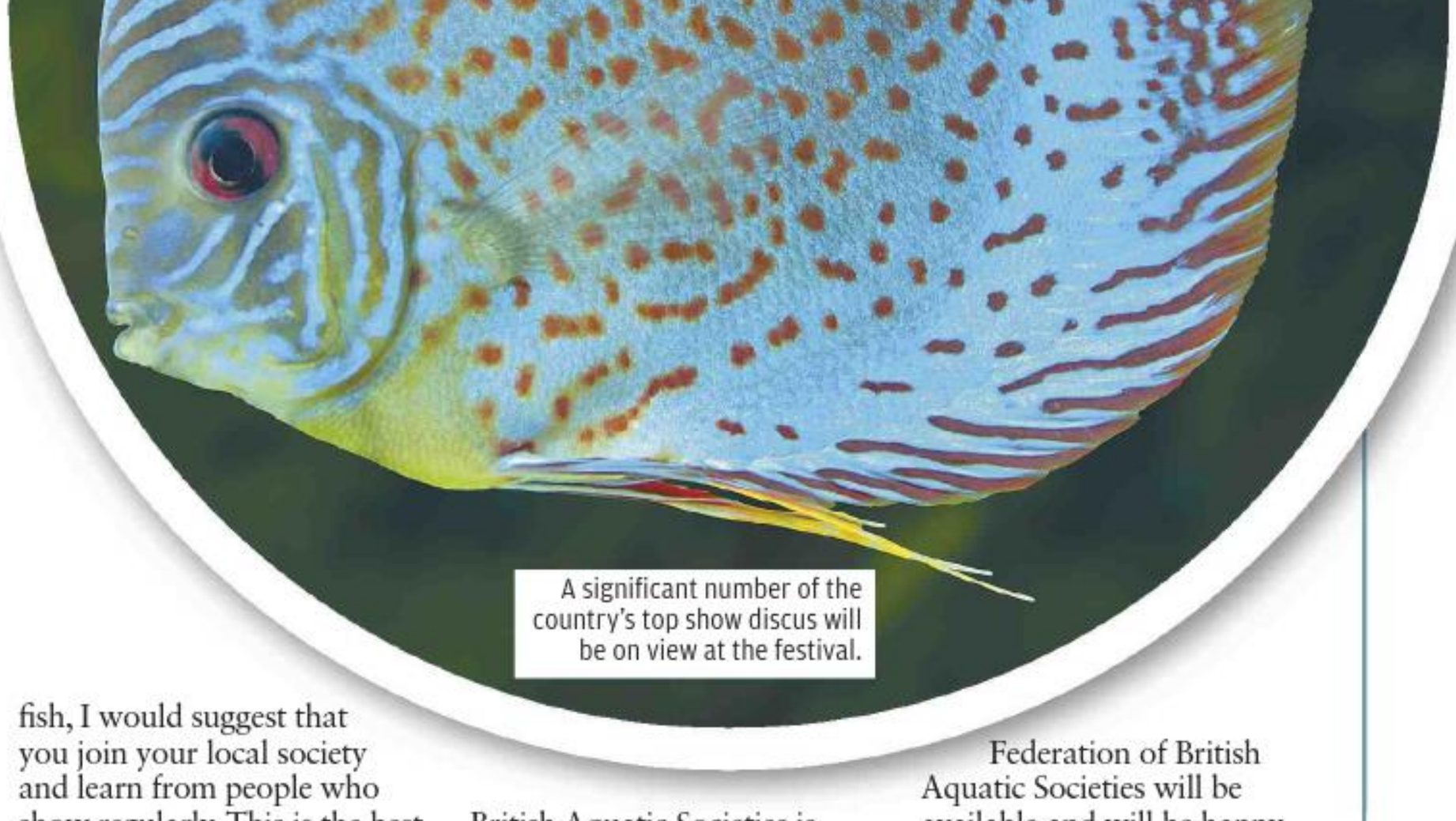
Colin: The Federation of British Aquatic Societies is the only organisation that continually grades all judges. They also stay in close contact with the their judges regarding any new fish on the show scene. All information can be found on the Federation's website www.fbas.co.uk and all the publications are available as free downloads at present.

I'm taking part in The Supreme Festival of Fish Keeping this year, which runs throughout the weekend of September 7th and 8th (See our news pages for more details – ED). This is a great opportunity to see what is involved in showing fish – and much more besides.

The event will host an Open Show, The Supreme Championship, The British Open, the finals of the Diamond Classes and the finals for the Pairs and Breeders Classes. It will be a real chance for the public to experience the thrill of seeing many different varieties of fish under one roof. Representatives of the Federation of British Aquatic Societies will be available and will be happy to answer any questions that might arise.

There will be judges available as well, to answer any questions relating to this aspect of the hobby. An information stand that will have the Federation of British Aquatic Societies' booklets on sale, as well as details about fish keeping and identification, is also planned.

This is the first such event taking place in the London area for many years. We look forward to seeing many newcomers over the weekend, so do please come and introduce yourself to us at the information stand.



A significant number of the country's top show discus will be on view at the festival.

Oscars can benefit from being colour-fed.

What to know more?

Free downloadable documents about fish keeping and showing can be found at www.fbas.co.uk/FBASPubsDL.html

Southern Florida, where tropical fish farming began in the USA.

Fish farming in Florida

The breeding of aquarium fish is no longer a small-scale, local occupation that is taking place in just a few localities. It has grown to become a worldwide phenomenon. Here **Andrew Mackinnon** reports on the earliest centre for commercial breeding, and how businesses there are faring, faced with ever-increasing worldwide competition, particularly from parts of Asia.

Florida is not only one of the most popular holiday destinations with British tourists in North America. It is also one of the world's major centres for the commercial breeding of aquarium fish. Fish keeping is the second most popular hobby in the USA, coming just behind photography. There is the equivalent of one aquarium for every nine households, with the vast majority of all the fish being kept there originating from the sunshine state of Florida.

The first tropical fish farm opened in Florida during 1926, and now there are nearly 200 such enterprises, generating over 100 million dollars annually and directly employing 1,000 people. The farmers export their stock to Britain and other countries around the world, as well as supplying fish throughout North America, and this activity now represents a huge international business.

The production of aquarium plants is also expanding rapidly, and is currently worth an additional five million dollars. A favourable climate has helped Florida to this position, but even today the breeding and rearing of tropical fish remains very much a family industry. It is based mainly within a 161km (100ml) radius of Tampa, with areas around Miami and Homestead still being quite important fish farming centres.

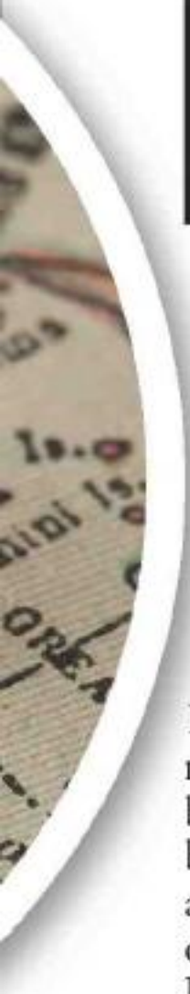
How the industry has developed

In the early days, the fish were originally shipped in large cans on railroads across North America. This obviously restricted the distances that they could be sent. But then, after the Second World War, the pioneering fish farmers began to hire ex-combat pilots to fly fish to destinations further afield. Ultimately, air transportation provided the possibility of exporting fish to the lucrative European market.

Today, however, the business has become much more competitive as US commercial breeders find themselves up against other farming operations in Hong Kong, the Philippines and other parts of Asia, where costs tend to be cheaper. They have responded by developing and breeding their own varieties of fish, such as gold dust mollies, as well as concentrating their efforts on spawning fish that are generally difficult to breed successfully, as well as growing on their fish, to offer them at larger sizes.

Typical set-ups

Individual pairs may be encouraged to spawn in their own aquarium: a single spawning in some cases can potentially yield many thousands of eggs and hopefully a similar number of offspring. Others may be bred by artificially



CLOCKWISE FROM TOP LEFT The speed of aircraft combined with a surplus of trained pilots originally served to open up the US market.

The ponds have to be covered to exclude Florida's range of fish-eating birds.

Other unwanted fish-eating guests could gain access to unsecured ponds.

Colour varieties have become important over recent years. This is a white form of the oscar (*Astronotus ocellatus*).

fertilising eggs, which tends to ensure a high rate of fertility. By this means, the parentage of the young fish can also be guaranteed - an important aspect of a breeding programme where genetic mutations are concerned. New mutations are carefully nurtured. They could well be worth a fortune to their breeder. Classes for such fish are held annually, as part of the Florida Tropical Fish Farms Association Show. Each spring, this major event attracts buyers from all over America and the rest of the world who are keen to see the latest developments in the industry.

The rearing system used for young fish is relatively standard. They are kept indoors in aquaria at first then transferred to outdoor ponds. There are more than 20,000 ponds for this purpose in Florida, and they may measure up to 46m (150ft) long and 15m (50ft) wide.

Growing on

The water often appears murky but it contains nutritious algae and insect life, enabling the fish to grow well and develop their coloration. Each pond may accommodate as many as 30,000 fish, and they will remain here from as little as two months up to a year, until they are large enough to sell.

The fish are then caught and transferred to holding tanks, where they are checked carefully. Finally, they will be divided into heavy duty plastic bags, half filled with water. The bag is then topped up with pure oxygen and sealed. In some cases, a tranquilliser may also be added to the water for nervous species. The bags are then packed in styrofoam-lined boxes which insulate the interior, before being dispatched to destinations throughout North America and further afield.

Careful preparation helps to ensure that losses are typically no more than one per cent. On long haul flights to Japan, for example, shippers often include special heat packs in the boxes to maintain the temperature. If this falls too low, not only will the fish be chilled, but their ability to fight off infections is also reduced as well. Conversely, in hot weather conditions, ice packs may be used to ensure that the fish do not become too hot. As cold-blooded creatures, they are not able to regulate their body temperature independently of their environment.

An uncertain future

How much longer Florida's fish farms can afford to stay in their present localities is unclear though. They are under increasing financial pressures because of the intense worldwide competition, with prices having risen very little in recent years, while costs have climbed significantly. Twenty-five years ago for example, a gourami would probably have fetched 17 cents; today that same fish will sell to a pet store for just 18 cents.

With the rising price of real estate in Florida, which has become such a popular retirement state, it can make economic sense to move. A number of fish farmers have already relocated to more remote areas on the edge of the Everglades as housing development continues apace.

Here, however, they may face further problems with predators. The ponds are usually covered to keep away birds but in some areas, raccoons are a real menace, gaining access to the ponds. Not only will they kill fish in large quantities, although rarely eating them, but they will also damage the supply pipes, causing loss of water.

Stranger creatures can also cause difficulties too. Giant cane toads, which are now living wild in Florida, having been introduced there, are one such potential hazard. They may give off a deadly poison if they can get into water alongside the fish.

The diversity apparent within the industry today is such that approximately 400 varieties of tropical fish are being raised on farms in the state, combined with more than 200 types of aquatic plants. In addition, a host of different crustaceans, molluscs and amphibians are being produced as well.

Increasing knowledge

One of the less conspicuous benefits of this cluster of ornamental fish farms in Florida is that considerable effort is being expended on research behind the scenes. The Tropical Aquaculture Laboratory of the University of Florida is actively carrying out research projects into the breeding of such fish, as well as their health, investigating which drugs can be used most effectively in this field. Management aspects are also being studied, looking at the design of breeding ponds, nutrition and related areas.

Quite apart from assisting the farmers themselves, the likelihood is that some of this work, such as the treatment of fish diseases, could well bring benefits to fish keepers and their pets throughout the world as well.

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Top Set-up Tip

Remember that shrimp soil must not be washed. This product is generally used by experienced shrimp keepers for more delicate types of shrimp. If you are starting with regular cherry shrimp or crystal shrimp, you do not need this special substrate.

How to set up a shrimp tank

In our first issue, **Lucas Witte-Vermeulen** of Sharnbrook Shrimp explained the appeal and scope of keeping these crustaceans in small-scale 'nano tanks'. Here he provides a step-by-step guide outlining how to create a suitable environment.

Having a stunning shrimp set-up on your desk will definitely not cost you a fortune, and the end result can be stunning, with the shrimp themselves being very relaxing to watch at close quarters. This particular aquarium is designed for the cheaper, hardier types of shrimp, such as cherry and crystal shrimp, making it ideal for an introduction to the hobby. The total cost is about £60, leaving aside the cost of the shrimp, which will probably add a further £15-20.

What you need (as shown above)

a) A tank (7.5l / 1.6gal is the minimum recommended size).
b) Lighting (LED or T5).
c) A small adjustable internal filter or an air-driven sponge filter.
d) Substrate (which is typically silver sand, gravel or shrimp soil).
e) Dechlorinator.
f) Beneficial bacteria to seed the filter, ensuring that is works more effectively at an early stage.
g) Plants, such as Java fern, that will thrive under low light conditions.
h) Mosses attached to stainless steel mesh or wood – *Fissidens fontanus* and spiky moss have been chosen in this case.
i) Shrimp caves come in various shapes and sizes. They are essential, providing somewhere for shrimp to hide away.

- Thermometer (optional).
- Heater (optional).
- Tap water.

Next time

Lucas explains how to test the water quality before adding the shrimp, and explains their feeding and general care needs. He also outlines the different types of shrimp that you can buy in the UK.

Contact point

For additional information and advice, contact Sharnbrook Shrimp.
Email: sales@sharnbrookshrimp.co.uk
Web: www.sharnbrookshrimp.co.uk
Tel: 0774 3589 999.

Popular Fish Keeping Expert guide... to setting up your shrimp tank

1 Add a suitable dechlorinator such as Mosura ShiZhen Power to the water, following the instructions on the bottle. If you do not have a dechlorinator, you can gently aerate water in a bucket with an air stone. After 48 hours or so, the chlorine will have come out of solution and dissipated, so the water should be safe. Even so, using a de-chlorinator is always the best option as it will remove potentially harmful heavy metals as well.

2 Wash the substrate. In this case, we are using fine black gravel. Black gravel is always preferred as it brings out the colour of the shrimp when they are seen against this dark background. Gravel and sand should be washed with warm water before use, until the water runs clear. Always read the instructions on the bag of whichever product you choose though, as various substrates often require slightly different treatments.

3 Place the gravel in the tank, to a depth of at least 2.5cm deep (1in), or follow the instructions on the bag.

4 Add water slowly to the tank, making sure not to churn up the substrate, until it is about 2.5cm (1in) from the top. Pouring the water on to a clean saucer placed on top of the substrate can help to prevent it being disturbed.

5 Install the filter. Submerge the filter fully in the water, preferably in the corner of the tank. Some filters come with spray bars. Switch on the filter and then adjust the flow rate if the current is too strong. Alternatively, you can use a small air-driven sponge filter, but bear in mind that these can become a bit noisy. However, these units are very safe for baby shrimp as they cannot get sucked into the filter.

6 Gently add the plants, trying not disturb the substrate. As you can see here, a Java fern has been grown on a shrimp cave and added as the centrepiece. You can buy them like this, or tie them on yourself with a piece of fishing line. Java fern will readily attach to anything, given some time.

7 Now you can attach the light. Select your lighting depending on the plants you have chosen. Low intensity LEDs are sufficient for mosses and Java ferns. However, if you want more demanding plants, you will need to look at stronger LED lighting or T5 tubes, plus fertilisers and even possibly a carbon dioxide system. We will just stick with a simple, basic set-up for now.

8 Next, add the moss using an implement like tweezers. It is always a good idea to have as little direct contact with the water as possible, because your hands will carry bacteria or even possibly soap residues which could be harmful.

9 Lastly, following the accompanying instructions carefully, add the bacterial culture to kick-start the nitrogen cycle in the tank.

10 You may want a thermometer to monitor the water temperature within the tank, although this is not essential if it is kept in a room that does not get uncomfortably cold or hot for you.

11 Supplementary heating is optional. It is recommended if the tank water is likely to drop below 18°C (64°F). Do not forget to adjust the thermostat on the heaterstat for this purpose, and fit a mesh cover around the heater.

12 Your tank is now finished, but wait at least two and preferably four weeks before adding any shrimp, in order for the filtration system to become effective. This is critical to the well-being of shrimp, just as it is in the case of fish.

Ready to go

Alternatively, you can always purchase a complete shrimp tank off the shelf. These sometimes come with built-in filters at the back, lighting, heaters and even substrate and other shrimp products. There are endless possibilities when it comes to creating suitable accommodation for shrimp, but my advice would be to obtain a relatively small, inexpensive set-up at the outset. Once you are ready and have gained some experience with keeping shrimp, then you can move on to more demanding set-ups and shrimp that have more specialised requirements as well.

FISH FOCUS

Tetra

"Ranking in the Top 10 of the world's most popular aquarium fish, tiger barbs show to good effect in shoals numbering five individuals or more"

Tiger barb
Systomus tetrazona

These popular aquarium fish, with their prominent striped patterning, are found over a wide area of southern Asia, extending from the Malay Peninsula via Sumatra to Borneo. They may also be known as Sumatra barbs, with their scientific name describing the four (=tetra) black stripes running down each side of the body.

Ranking in the Top 10 of the world's most popular aquarium fish, tiger barbs show to good effect in shoals numbering five individuals or more. They are often included in community tanks alongside other fish, but companions need to be chosen carefully, as tiger barbs are determined fin-nippers.

Tiger barbs will tend to harry fish with trailing fins, biting at this part of their bodies, and for this reason, they should never be housed in aquariums with angelfish or Siamese fighting fish. Suitable companions can include other, relatively fast-swimming species such as danios.

A variety of colour forms of the tiger barb have now been created. These include green tiger barbs, which are more evenly coloured, displaying far less contrast in terms of their markings. Albino and golden varieties are also quite common.

Tiger barbs are generally easy to care for, taking a varied diet. Livefood is an important breeding conditioner. Adult females swell with spawn, while males develop a red area above the upper jaw. Special breeding tanks need to be set up, because otherwise, the adults will eat their eggs after spawning.

Key info:

Grows to: 10cm (4in)

Water chemistry: soft and acid-neutral

Water temp: 26-28°C (79-82°F)

A photograph of the Rift Valley lakes, taken from space. *PHOTO COURTESY NASA.*

Red Jacob Peacock African cichlid

African lake cichlids

The story of how a journey to the Galápagos Islands inspired Charles Darwin to formulate the theory of evolution is well-known, but more recently, it has been the lakes in Africa's Rift Valley that have attracted the interest of evolutionary biologists. **Sue Reid** reports.

The Rift Valley is one of the continent's most prominent features, even being visible from space. It extends over a distance of some 6000km (3700ml), right from the Red Sea down to Mozambique. It marks a geological fault line, where the ground level has sunk, and is still sinking today, creating what geologists refer to as a trench.

Rather than rivers, a series of over 20 different lakes of various sizes can now be found running along the length of Africa's Rift Valley. The largest and most significant lakes are Lake Victoria, lying furthest north, plus Lake Tanganyika and also Lake Malawi, which is the southernmost of the three.

Lake characteristics

Lake Tanganyika not just is the oldest of the three, dating back over six million years, but also the deepest, plummeting to a maximum depth of around 1500m (4900ft). This makes it the second deepest lake anywhere on earth, after Siberia's Lake Baikal, and it is also the longest lake, stretching for a distance of 660km (410ml).

In contrast, Lake Malawi formed more recently, probably about two million years ago, and like its northerly counterpart, it is set in a deep trough of ground, reaching a maximum depth of around 600m (1950ft).

Cichlids could not survive at these depths, because of the lack of oxygen in the water. These two African Great Lakes are rather like seas, reflecting their massive size, but there is one obvious significant difference. Their location means that they are sheltered, and protected from winds that would blow across the water, and increase the level of oxygenation in the water.

These huge lakes do not just look like seas, but the fish living within them have been likened to those found around marine reefs, based on their

wide range of colouration and diversity in form.

The situation is slightly different with Lake Victoria, which began life as a series of relatively shallow, smaller lakes, and then the water level rose, causing them to become a single lake. Over the course of millennia, so the water level here has fluctuated markedly, as in the case of the other lakes, but there is evidence to show that Lake Victoria nearly dried up entirely around 12,500-15,000 years ago. If this did indeed happen, this means that all the species of fish in the lake today are of more recent origins.

The fish

The positioning and depth of Lake Victoria means that it is better suited to provide different habitats for fish than either of the other major lakes. But the question is as how did fish reach any of these lakes, given their isolation today?

While we simply cannot be sure, evidence suggests that they entered from rivers that connected with the lakes during their early stages of development. The lakes are thought to have formed near the headwaters of the rivers. As a result, it is likely that there would have been relatively few species of fish present here, suggesting that all of today's Rift Valley cichlids are descended from a very limited ancestral stock.

Recent research into the mitochondrial DNA of the cichlids now living in Lake Victoria supports this theory. Out of 14 recognised species drawn from nine different genera that were studied, it was found that they showed less genetic diversity than has been detected between individual people! Their incredibly close genetic relationship is a very strong indicator that all these cichlids are descended from a single ancestor in the recent past.

Lake Tanganyika, on the other hand, has a much more clearly defined variance in its cichlid population. As the oldest of the three lakes, this would be anticipated, because there has been a longer time interval for its fish to change in appearance.

Cichlids existing there range from just 3.75cm (1.75in) long, right up to the emperor cichlid (*Boulengerochromis microlepis*), which is the largest known species of cichlid found anywhere in the world. Males of this predatory species can grow to at least 91cm (36in) in length, with females being slightly smaller.

Some areas for example have a sandy base, where others localities are typified by having an uneven rocky floor. The aquatic vegetation varies too, being prevalent in some areas but not others. This in turn offers a varied range of individual habitats.

Practical considerations

The shallows around the southern end of Lake Tanganyika are home to a

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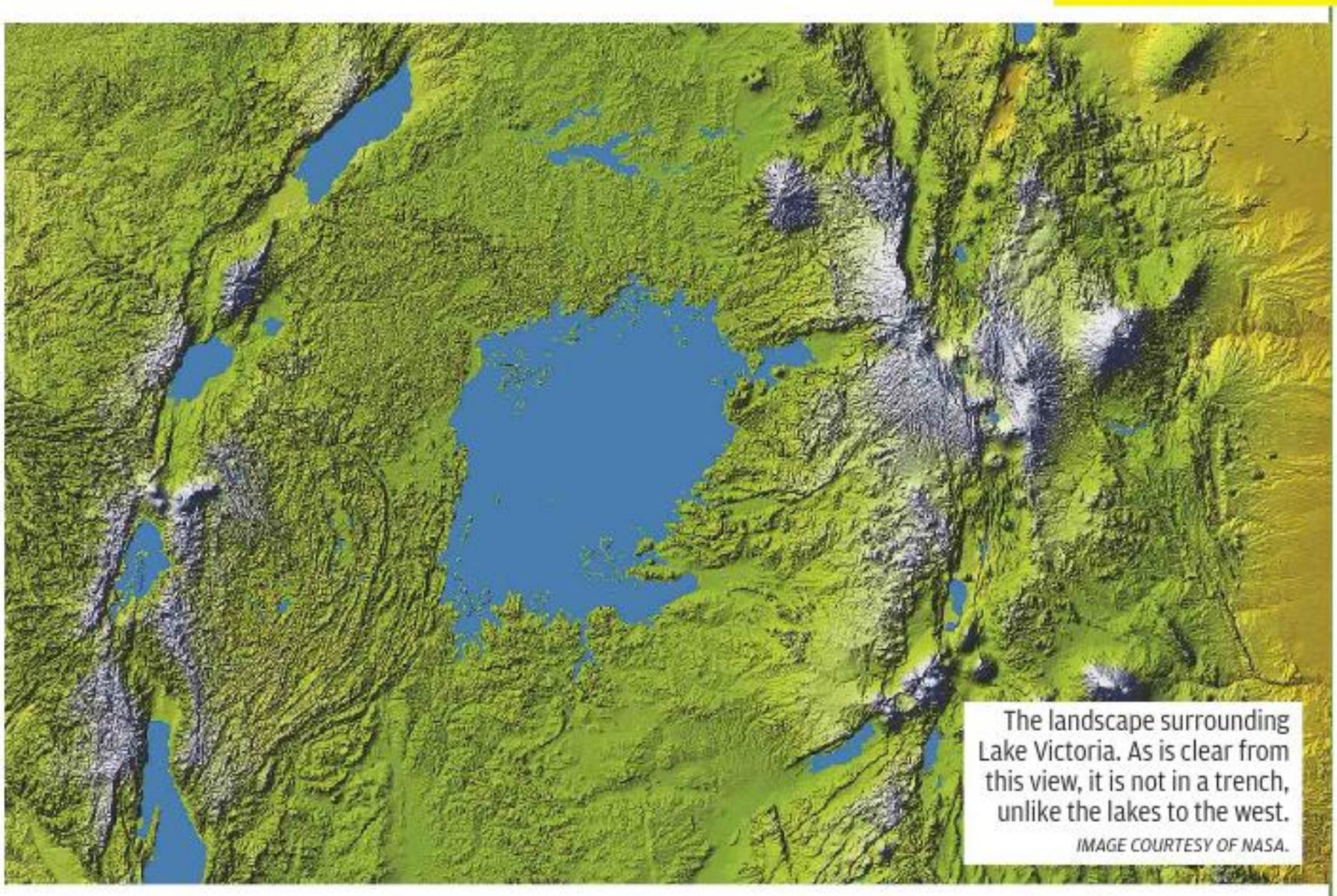
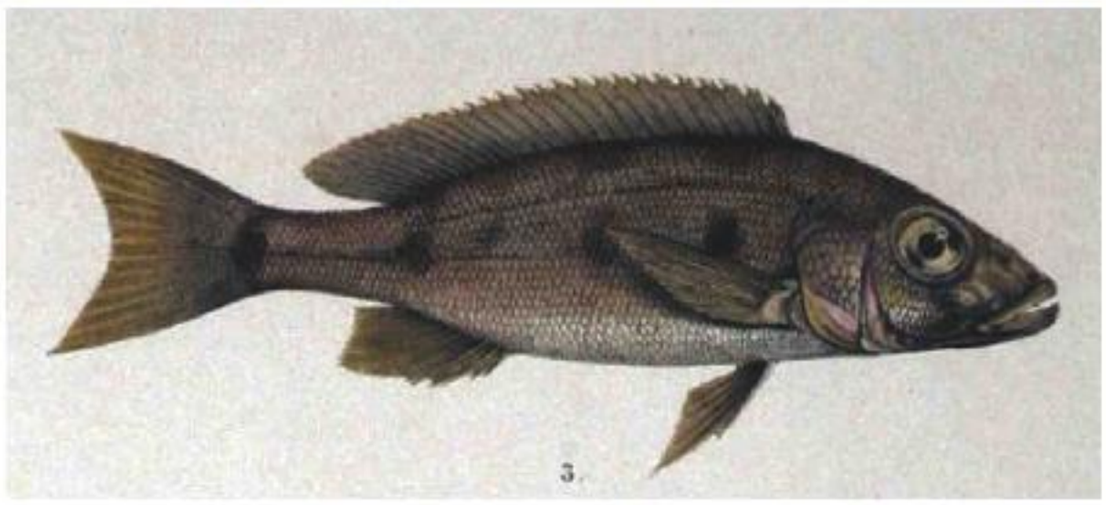
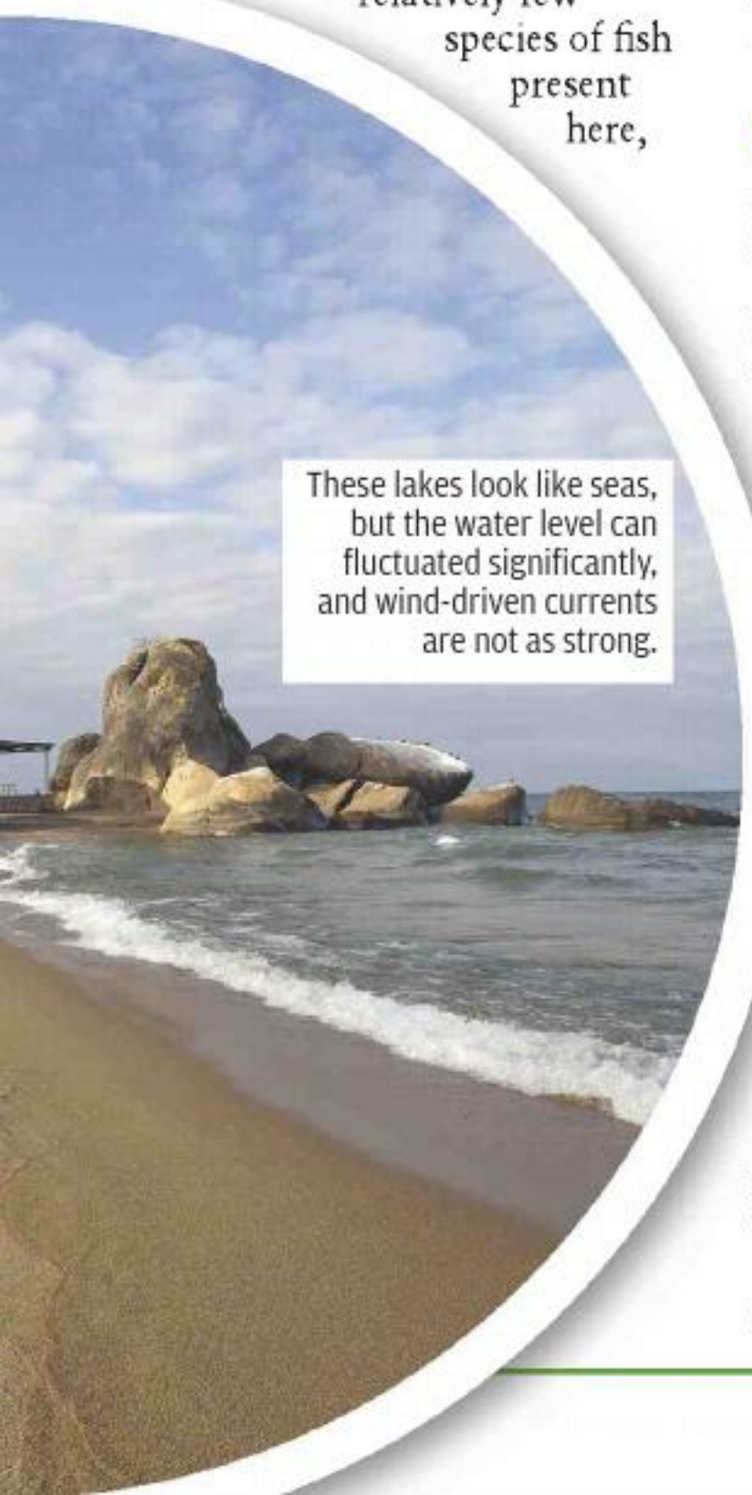


The landscape surrounding Lake Victoria. As is clear from this view, it is not in a trench, unlike the lakes to the west.
IMAGE COURTESY OF NASA.



ABOVE An early portrayal of the emperor cichlid, by the man whose name is commemorated in the genus to which it now belongs: George Albert Boulenger (1858-1937).

RIGHT The appearance of Lake Victoria below the water varies significantly in different areas of the lake.



These lakes look like seas, but the water level can fluctuated significantly, and wind-driven currents are not as strong.

Factors leading to biodiversity

Although it is easy for us looking at these lakes to seem them as vast expanses of water, the scene underwater is very different. There are wide variations not just in depth, as already mentioned, but also in terms of the underwater topography of the lakes.

Another form of the same fish, which is often described as the red kaiser.
PHOTO COURTESY PHOTOMAX AT THE GOLDFISH BOWL

"Colouration has actually played a very important part in the diversification that exists within Rift Valley cichlids today"

cichlid known under the scientific name of *Tropeus moorii*. It is one of the features of the fish found in this region that they often tend to be referred to by the species component of their name, meaning that these popular aquarium fish may be known in the hobby as moorii.

But if you are seeking to have a group of these cichlids, simply knowing their name will not be enough to ensure that you acquire similar specimens, if you seek to purchase them from different sources. This reflects the fact that the population of moorii has split up, thanks largely to physical obstructions such as rocks and boulders underwater in the lake.

The fish seem unable to swim round these, by heading out further into the lake. As a result, they have reached the point of forming local populations that have already changed significantly in appearance, in terms of their colouration in this case.

Those from the vicinity of Kiriza, for example, have a bright yellow band around their bodies, with this phenomenon being known to biologists as polymorphism. In such cases, different forms of the same species exist, although ultimately, a stage will be reached when populations are so different that they will then be classed as distinct species. The difficulty is in determining when this point has been reached!

There are more than 40 different morphs of moorei that have been recognised, and so in order to distinguish between them, their name typically has their locality in the lake appended to it, such as *Tropheus moorii* 'Bemba'.

Tropheus moorii, which probably originate from the area of Kiriza, browsing on algae.
PHOTO COURTESY THOMAS ERNST.

ABOVE Brilliant yellow colouration is often a feature of the lemon cichlid or leleupi (*Neolamprologus leleupi*) found in rocky areas of Lake Tanganyika, but it depends on the locality. Other members of this species are brown. These fish spawn in caves. *PHOTO COURTESY PHOTOMAX AT THE GOLDFISH BOWL*

Clues with colour

Colouration has actually played a very important part in the diversification that exists within Rift Valley cichlids today, with these fish possessing good colour vision. This is vital to

CONTINUES ON THE NEXT PAGE »

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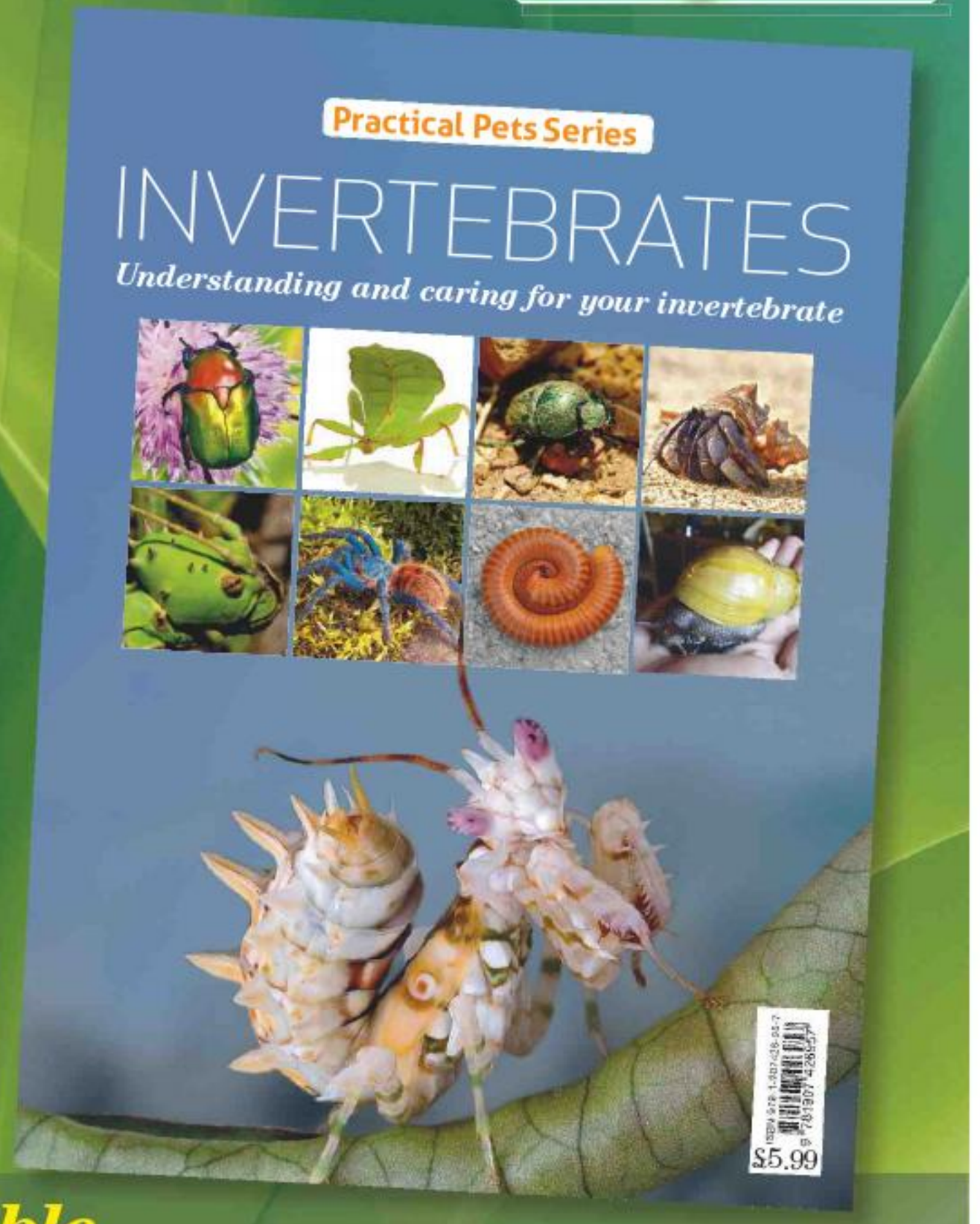

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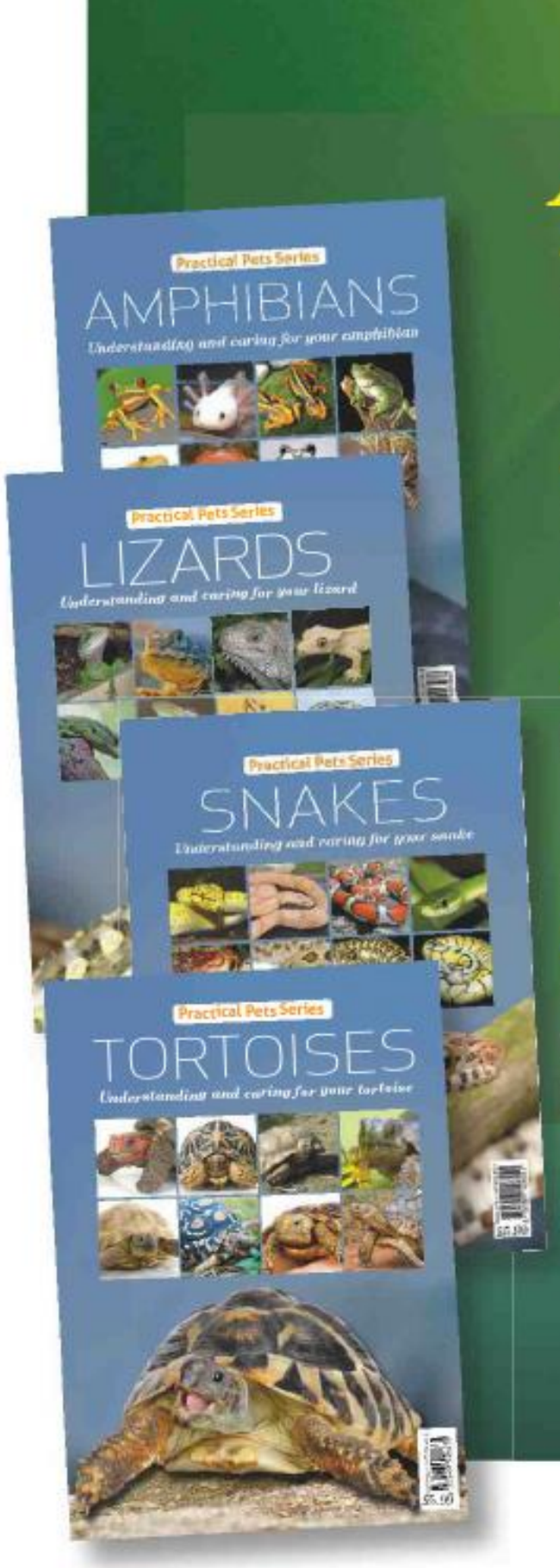

Amphibians covers frogs, toads, newts and salamanders, focusing on the most widely kept groups such as fire salamanders, dart frogs and fire-bellied toads. The expert text provides a comprehensive overview of the care and breeding of such creatures. It will prove to be an invaluable reference, whether you are just starting out, or are already an experienced amphibian keeper.

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A hybrid cichlid known as the strawberry peacock, created in the aquarium – but hybridisation is becoming increasingly frequent in the wild too.

"Shades of yellow and red are most evident at greater depths, whereas blue tends to show up well closer to the surface. "

Studies of the fish population of the volcanic Lake Barombi Mbo have provided valuable insights into the way that speciation – development of species – has occurred in the African Rift Valley lakes.
PHOTO COURTESY NASA.

prevent hybridisation, where potentially similar fish are living in the same general area. Shades of yellow and red are most evident at greater depths, whereas blue tends to show up well closer to the surface.

As a result, it is perhaps not surprising that over the course of their development, so cichlids have altered in terms of colouration. This enables females to recognise males more easily, depending where they are swimming.

You can now gain a reasonably reliable insight into the area of the lake where a particular species is found. Blue males tend to occupy the upper areas of water, normally being found closer to the surface than those displaying red or yellow colouration.

Unfortunately, in Lake Victoria, the waters are no longer as clear as they were, thanks to human interference in the environment. There has therefore led to a breakdown in this system of identification, with more random pairings taking place.

This is now starting to reverse the process of speciation, since such matings result in the production of hybrid offspring. Thanks to the close genetic relation between these fish, their young are also fertile.

No-one knows just how many Rift Valley cichlids exist in these lakes. It has been suggested in the case of Lake Malawi, there could be anywhere from 1000-1600 species, but at present only about 500 have been formally described by scientists. It is a staggering thought, however, that there are already known to be more species of cichlid in this single African lake than are present in freshwaters areas of both North and Central America combined!

One of the difficulties in determining the number of species in Lake Malawi is that in some cases, male and female cichlids of the same species can differ quite widely in colouration. As shown, a female auratus cichlid is more brightly coloured than a male of the same species (*Melanochromis auratus*).

Separating the sexes.
PHOTO COURTESY PHOTOMAX AT THE GOLDFISH BOWL

The breeding behaviour of Rift Valley cichlids is very diverse. The dolphin cichlid, so-called because of the shape of its head, is a mouth-brooding species found in Lake Malawi.

PHOTO COURTESY PHOTOMAX AT THE GOLDFISH BOWL

In contrast, this small cichlid called signatus (*Lamprologus signatus*) from Lake Tanganyika is an egg-laying species. Females seek out small shells where they can lay their eggs though, rather than doing so in the open.

How it may have started

It is not just cichlids that have undergone such relatively rapid change from their ancestors, but other forms of aquatic life too, such as snails. Yet do we have any insight into how this colonisation by perhaps just a single species or two may have started, leading to the amazing diversity of life that exists in these lakes today?

The answer is yes, based on studies carried out at a much small volcanic lake called Barombi Mbo. A small stream feeds into the lake, oxygenating the water at this point, whereas at the opposite end, where it leaves the lake, so nutrients tend to sink down out of suspension, because of the lack of water flow here.

The cichlids carried into Lake Barombi Mbo apparently separated into what were originally two distinct groups at either end of the lake. Those that congregated around the lake's inflow, where the water was more turbulent, carrying edible items up to the surface, changed over time to become surface feeders. Cichlid inhabiting southern parts of the lake became adapted to follow the food to great depths.

Both populations prospered under these circumstances, and so expanded their ranges, ultimately coming into contact with each other. Then more marked changes began to occur. When the southern population of cichlids encountered their northern relatives in the southern part of the lake, they reacted by moving into shallower water, thereby avoiding competition.

Yet when southern cichlids moved north however, so the reverse happened, and they began to exploit deeper water there. This population has now established a remarkable ability to dive down in largely unoxygenated water, to feed on fly larvae. This is made possible by changes to the oxygen-carrying molecule known as haemoglobin, present in their red blood cells.

Meanwhile, the cichlids that moved into the shallow waters of the lake have split again, into a population that feeds during the daytime, and another that is nocturnal. This shows just how diversity can become established, with five species evolving from the original fish.

Mouth-brooding in action, with this behaviour being displayed by the golden Mozambique mouthbrooder (*Oreochromis mossambicus var.*), an African species occurring outside the Rift Valley lakes.

PHOTO COURTESY PHOTOMAX AT THE GOLDFISH BOWL

The importance of oxygen

Oxygen levels in the water are one of the significant habitat factors that have driven the development of the Rift Valley cichlids. This has affected their reproductive habits too, because even relatively close to the surface, oxygen levels are relatively low – below those that would be anticipated in most rivers as an example.

Some cichlids simply lay their eggs in shallow pits that they excavate in the substrate, remaining close-by and fanning them with movements of their tail. This has the effect of increasing the oxygen level around the eggs, by improving the circulation of water. Others, though, have opted for a different method, becoming mouth-brooders.

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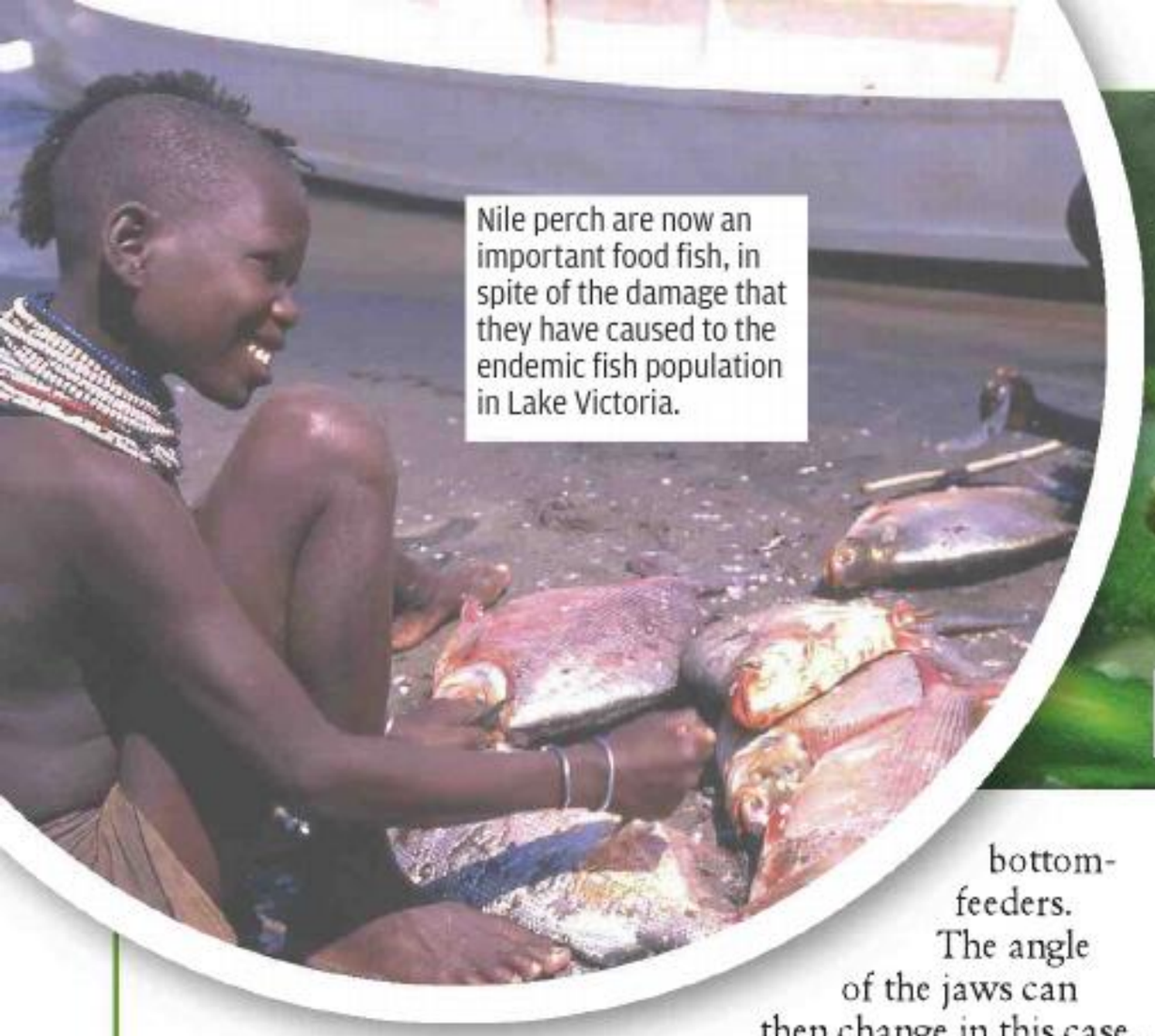
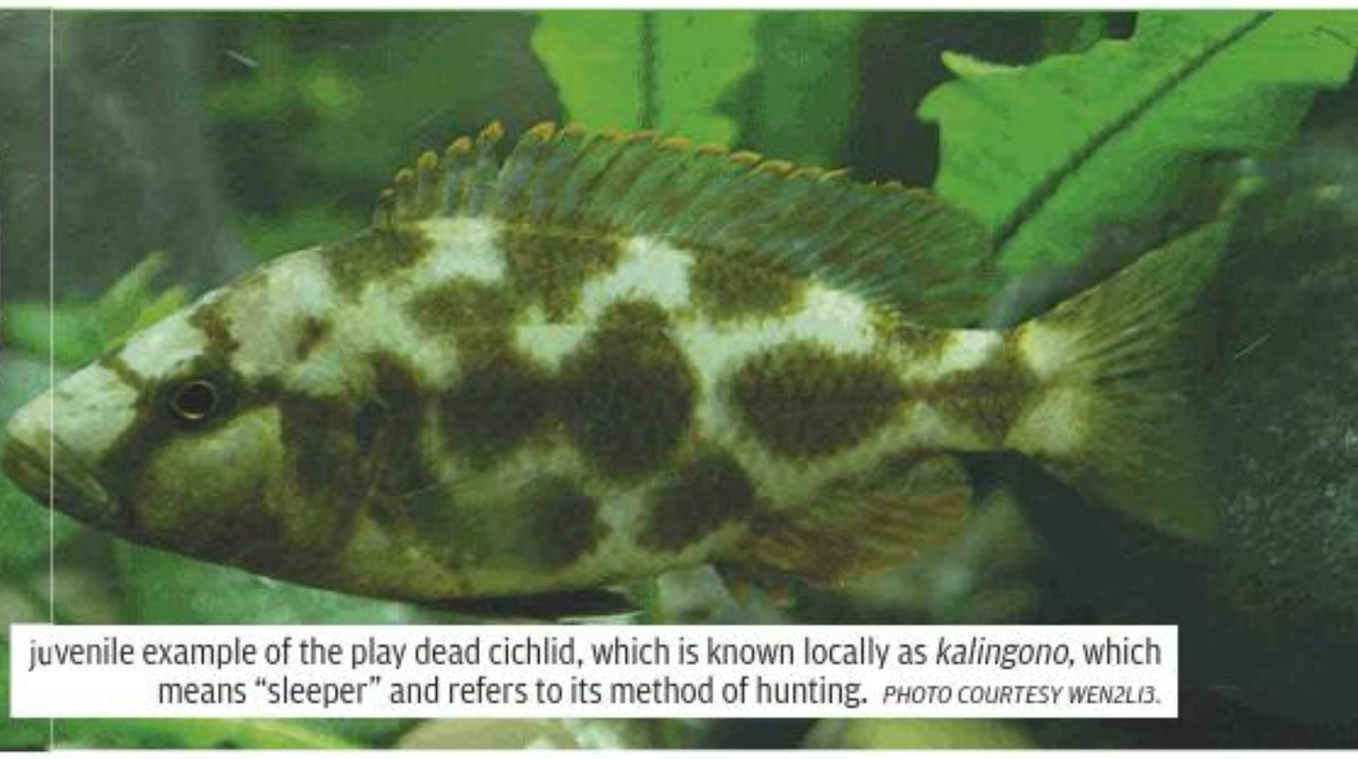


Nile perch are now an important food fish, in spite of the damage that they have caused to the endemic fish population in Lake Victoria.



juvenile example of the play dead cichlid, which is known locally as *kalingono*, which means "sleeper" and refers to its method of hunting. PHOTO COURTESY WEN2LI3.

Following spawning in such cases, the eggs are then collected up and transferred to the mouth, where the fry will ultimately hatch. This obviously keeps the eggs relatively safe, and out of reach of predators. But it also brings other, very specific advantages, firstly in ensuring the eggs are not lost into the void of the lake.

Furthermore, mouth-brooding serves to oxygenate the eggs as well, as water is drawn in through the mouth, before passing over the gills. Ultimately too, it also restricts the distribution of the fish though. The eggs are not wafted away on water currents, as would tend to happen in river systems.

Other, more unusual behaviours reinforce this isolation. These have arisen in order to attract the attention of a female, as shown by cichlids that use sandcastles for this purpose. Males may painstakingly construct mounds of grains of sand, piled up into what are effectively underwater towers, reaching heights of 4ft (1.2m) or more.

Rapid change

Another aspect that has favoured the increased diversity in this group of fish is believed to be their jaw structure. In most cases, changes occur slowly, through the generations, but in this case, alternations occur very quickly. This has been noted as a result of commercial breeding of such cichlids, where food is placed on the surface of the water, even for those that are traditionally bottom-feeders. The angle of the jaws can then change in this case, allowing these particular cichlids to start feeding more easily at the surface. This also signals a warning, because clearly, breeding Rift Valley cichlids can result in surprisingly rapidly changes in their physical appearance. Most breeders concentrate on the colouration of their fish, seeking to develop the brightest colours, rather than worrying too much about subtle changes of this type, and yet these could be very significant.

Cichlids have also proved to be highly opportunistic, as well as adaptable. This is best typified perhaps by the case of the play dead cichlid (*Nimbochromis livingstonii*), which as its name suggests, lies on the sand, mimicking a dead fish with its patterning. This attracts small potential scavenger fish that can then be snapped up by the supposed corpse.

"But perhaps the biggest threat to these unique cichlid communities is the Nile perch."

An uncertain future

It is self-evident that much still remains to be learnt about the cichlids and indeed, other fish living in Africa's Rift Valley lakes. These areas provide unique habitats where changes in nature can be detected quite rapidly, which is why this region is so significant to evolutionary biologists.

Unfortunately though, a growing human population in the area, and increasing demand for food, is putting these fragile ecosystems under serious threat. It is quite possible that some unique cichlids have already disappeared, before they were even recorded by science.

The problem of murky water and mate selection has already been mentioned. This has been caused in Lake Victoria by the clearance of trees on the slopes surrounding the lake, leading to erosion of soil, some of which then ends up being washed into the lake, making it murky. The lack of light in the water is likely to impact on the aquatic vegetation here as well.

But perhaps the biggest threat to these unique cichlid communities is the Nile perch (*Lates niloticus*). These large and highly aggressive predatory fish were deliberately released during the 1950s into Lake Victoria. They can ultimately end up weighing as much as 61kg (135lb), and may grow to 1.8m (6ft) or so. Although these perch have proved to be a valuable source of food for local people, their arrival has seen traditional catches of cichlids from the lake decline significantly since the 1980s. Worse still, it is the larger, more predatory cichlids that are most under threat. Both types of fish are drawn to the same microhabitat for hunting purposes. They patrol the open areas of the lake where hunting is easiest, away from the rocky edges or the areas where there is a lot of aquatic vegetation that provides cover.

But there are already signs that these particular cichlids are fighting back, by becoming sexually mature at a smaller size, as a result of suffering heavy predation. This then enhances their chances of survival, as they can breed when they are younger.

Health concerns

It has proved possible for cichlids and Nile perch to co-exist, as shown by the situation in Lake Tanganyika, and a more benign relationship may develop in Lake Victoria too, particularly given the heavy pressure being applied to the latter species by the fishing industry. But meanwhile, the largely unnoticed benefits of cichlids to the local community, over and beyond their value as a source of food, are becoming very apparent, as the populations of key species are also themselves being badly affected by over-fishing.

In Lake Malawi, the number of cichlids that eat water snails has declined markedly, allowing the snail population to increase dramatically. The number of cases of the human illness known as schistosomiasis, which is carried by aquatic snails, have doubled in children in little more than 20 years, bringing misery. The illness stunts their growth and affects their cognitive development.

Now there are serious fears about the continued spread of an introduced aquatic plant called water hyacinth (*Eichhornia crassipes*). This will protect the snails that carry the disease, by growing in dense mats where the molluscs will then be largely out of reach of predatory fish, even if the cichlid population recovers.

● There will be more about African Rift Valley cichlids and information on how to keep them successfully in our next issue.

Puzzle page

See if you can solve the puzzles here! You can find all the answers on page 98.

PLANT LIFE

Seventeen of the listed genera of aquarium plants have been hidden - up, down, diagonally, back and forth - in the grid. Which one has gone missing?

ALTERNANTHERA, AMMANNIA, ANUBIAS, APONOGETON, BACOPA, CABOMBA, CARDAMINE, CRINUM, CRYPTOCORYNE, ECHINODORUS, EGERIA, HYGROPHILA, LIMNOBIUM, LUDWIGIA, ROTALA, SALVINIA, TONINA, VALLISNERIA

C	R	Y	P	T	O	C	O	R	Y	N	E
L	I	M	B	N	O	R	U	M	T	A	N
A	N	I	N	O	T	I	A	V	I	S	I
L	L	A	M	D	U	N	T	O	S	K	M
T	W	U	Y	N	U	U	F	A	L	M	A
E	J	G	D	B	O	M	L	U	S	I	D
R	B	A	I	W	O	V	C	N	U	O	R
N	V	A	L	L	I	S	N	E	R	I	A
A	S	I	C	N	A	G	Y	A	O	J	C
N	O	W	I	O	T	R	I	N	D	I	M
T	R	A	X	T	P	R	N	A	O	H	T
H	I	B	L	E	E	A	X	I	N	A	C
E	S	H	Y	G	R	O	P	H	I	L	A
R	A	V	E	O	D	W	A	C	H	I	B
A	M	M	A	N	N	I	A	L	C	M	O
M	U	S	K	O	T	W	Y	S	E	N	M
V	O	L	A	P	T	L	I	M	N	O	B
M	U	G	R	A	B	R	O	T	A	L	A

PUZZLE IT OUT

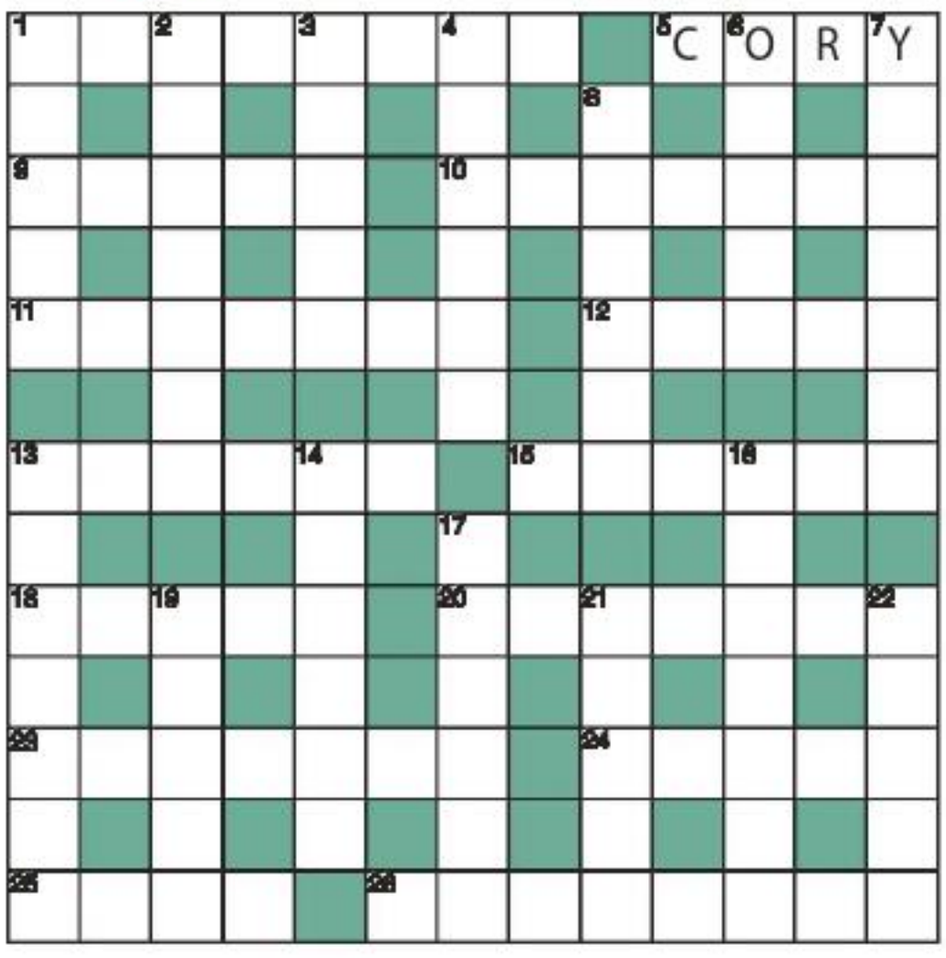
Solve the crossword in the usual way except that where a clue is represented by asterisks, you must enter a word that has some connection with the solution already given - CORY.

ACROSS

1 * * * * * * * * (8)
5 CORY
9 Baby's diaper (5)
10 Butter up with compliments (7)
11 Leather case worn to carry pistol (7)
12 * * * * * (5)
13 Pulsates (6)
15 National song (6)
18 Maxim or slogan (5)
20 Loose sleeping suit of pants and jacket (7)
23 Light persistent rain (7)
24 Slack (5)
25 Yellow part of an egg (4)
26 Screamed in a shrill way (8)

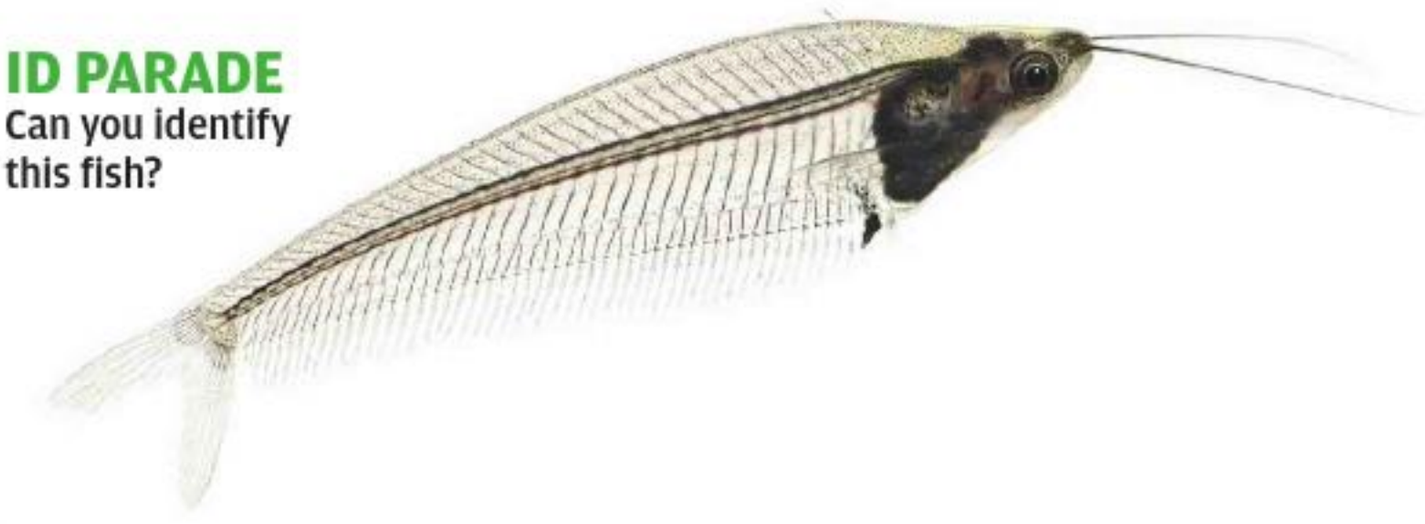
DOWN

1 Blow struck by boxer (5)
2 Well-liked by many (7)
3 Africa's land of the Pyramids (5)
4 Endeavour, exertion (6)
6 Frequently (5)
7 Outer part of ship's sail spar (7)
8 Occur, take place (6)
13 Nervously, with faint heart (7)
14 * * * * * * (6)
16 Suspended slung canvas for sleeping on (7)
17 Oration (6)
19 Criminal court case (5)
21 * * * * * (5)
22 Pace of movement (5)



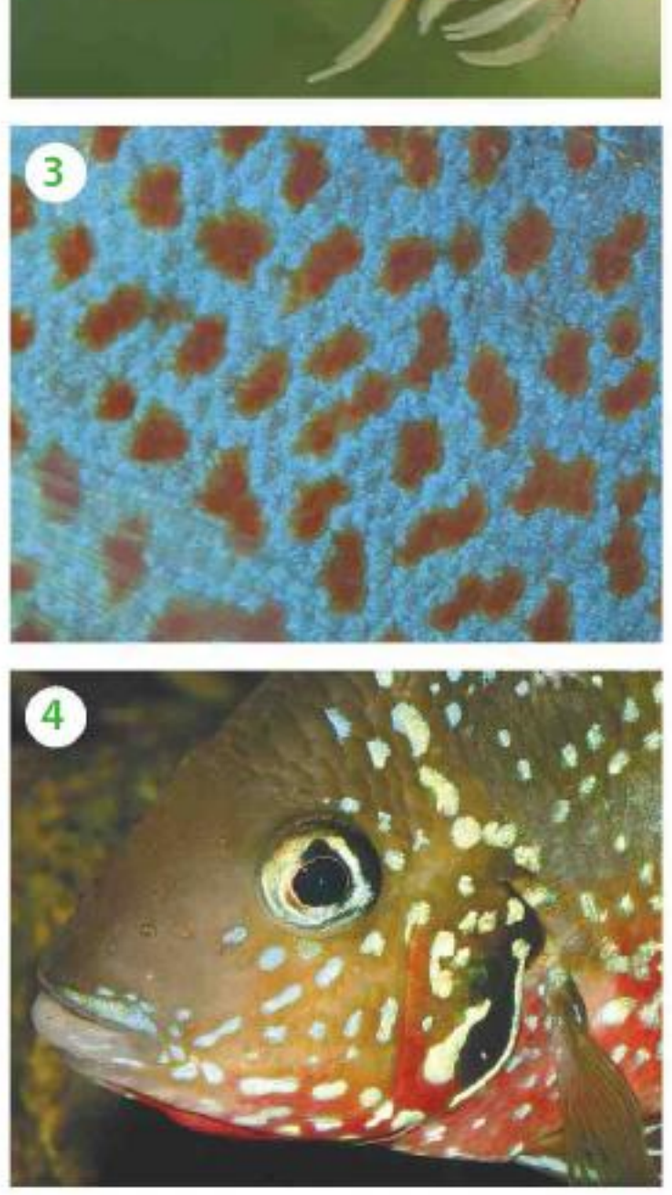
ID PARADE

Can you identify this fish?



WHICH FISH IS THIS?

Pictured below are close-ups of five different fish. Can you tell what they are?



Time for the substitutes

Following the assumption that there is nothing better than a big shoal of fish (apart from perhaps a shoal of big fish?), to complete your new tank, what are the choices that come immediately to mind? asks **Dick Mills**.

A shoal of neon tetras, with an albino corydoras catfish in the centre of this photo.

In this situation of course, it is almost certain to be either neon or cardinal tetras, because a large shoal of either of these species looks fantastic. But there are alternatives, if you want to try something different, although is it really necessary to pick shoals of fish? What about individuals?

Leaving aside the issue of the visual impact of the tank, the fact is that many aquarium fish have what can only be described as a shoal mentality. They rely on safety in numbers. If you are part of a large group, then hopefully, a predator will prey on another individual rather than you. Furthermore, group living makes it much easier to find a partner, who may be just a fin's width away. Of course, this might even lead to a synchronous spawning by the whole shoal!

Safety in numbers

In the aquarium, where the fish should be completely safety from predators, this sense of security is still to be found in those species wanting to share their swimming space with their own kind. There are several instances of fish that reportedly may simply pine away if kept apart from members of their own species, albeit in a crowded community tank. Typically, clown loaches as well as glass and corydoras catfish are amongst the more gregariously-minded species.

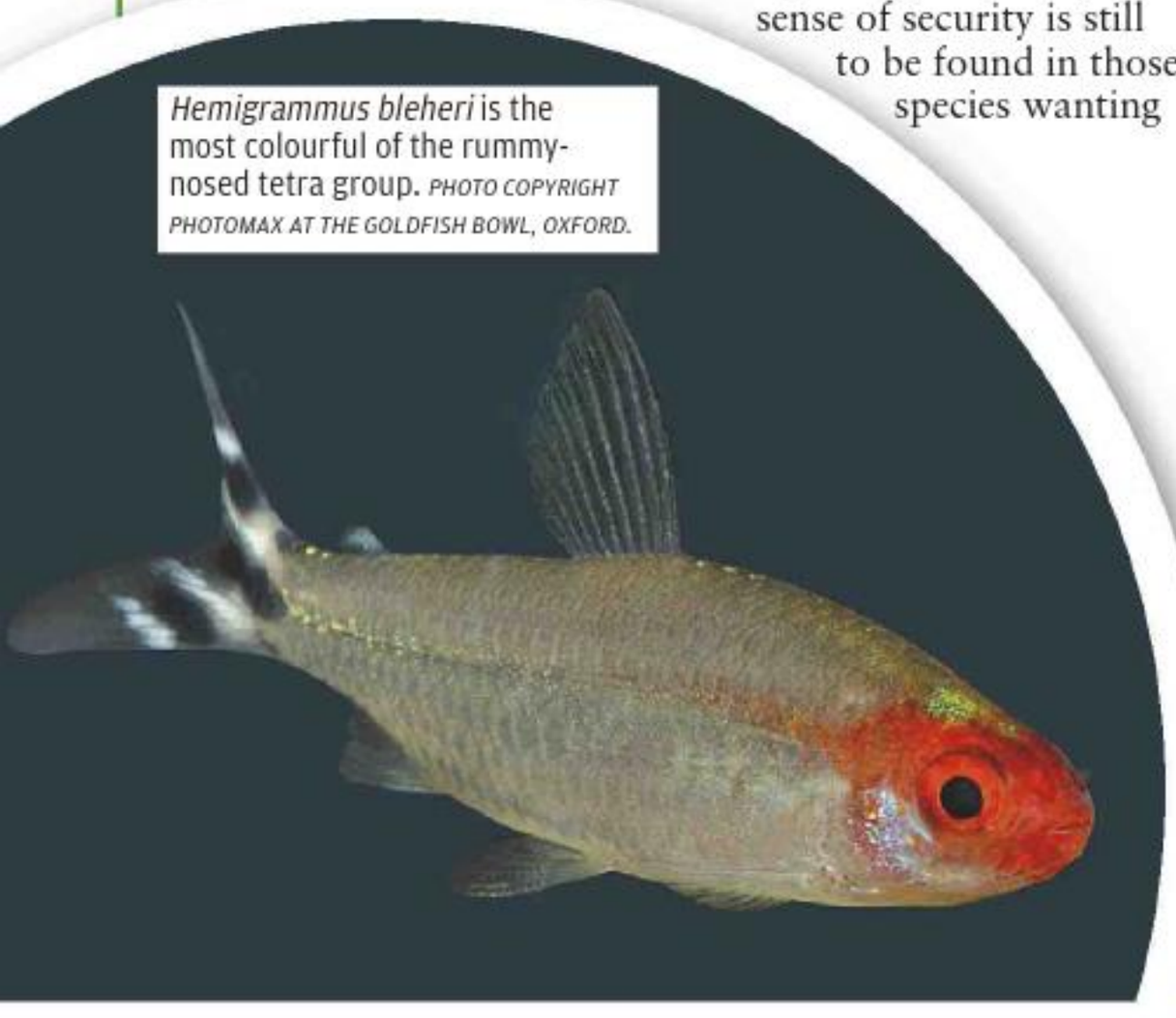
As a way of emphasising this sense of group safety, the fish will feel more at ease, behaving naturally and being on the move, which means that adequate swimming space must be available. Make sure that they are accommodated in a well-planted aquarium – with length being the most critical dimension, while depth is less significant.

There should also be generous open spaces where the fish can swim together and yet they must also be able to find shelter should they need it. Another consideration is that shoaling fishes are often, although not always, fast-swimmers, so a strong water-flow through the aquarium can make them feel even more at home.

As the aim is to create a stunning aquascape, it is important to furnish the aquarium so as to show the fish at their best. Paradoxically, this does not necessarily mean strong lighting, even if it is needed to grow the plants; should tall plants be included in the aquarium, then the shade provided by their trailing leaves will be welcomed by the fish. Don't forget that a large piece of bogwood not only looks good but its dark colouration (together with a dark substrate too) will serve to bring out the natural colours of the fish to perfection. Always seek to give your fish choices – swimming in the open or hiding in the plants – because by giving them this choice, they should also feel more secure, knowing they can dart into cover. This then means that they should be less nervous.

Making a choice

Next it is a time for decisions. In order to comply with popular taste to some extent, I will restrict my choice of fish to various characins, and more specifically to tetras. They are usually relatively modest in size, decorative,



Hemigrammus bleheri is the most colourful of the rummy-nosed tetra group. *PHOTO COPYRIGHT PHOTOMAX AT THE GOLDFISH BOWL, OXFORD.*

ABOVE The false rummy-nosed tetra.

readily available and yet not too expensive, but there is a good range to choose from as well.

The rummy-nose tetra actually comes in three distinct packages – there is *Hemigrammus bleheri* from Colombia and Brazil; *Hemigrammus rhodostomus* found in the the lower Amazon, and their lookalike relative *Petitella georgiae*, inhabiting stretches of water in Brazil and Peru, which is sometimes described as the false rummy-nose tetra.

Telling these species apart is not too hard, although it sometimes comes down to an interpretation of the differences between black and white. The most important point of distinction between these similarly-sized fish, however, is in the amount of red colouration on the head. That of *H. bleheri* spreads much further back over this part of the body, whereas in the other two species, the red is restricted much more to the snout.

Looking at the caudal fin ought to give another clue: that of *H. rhodostomus* looks more like alternate black and white areas superimposed on a clear fin (as the clear lobes are easily seen). The caudal fins of *H. bleheri* and *P. georgiae*, however, are much blacker with thinner white stripes in-between; this colouration appears to reach to the ends of the caudal fin, as very few clear areas can be seen on the lobes.

These species all make excellent companions for discus, with whom they share a liking for very precise, soft water conditions. Choosing rummy-nosed tetras could be seen as a bit of a gamble,

Black phantom tetra.
PHOTO COPYRIGHT PHOTOMAX AT THE GOLDFISH BOWL, OXFORD.

Congo tetra. *PHOTO COPYRIGHT PHOTOMAX AT THE GOLDFISH BOWL, OXFORD.*

as many aquarists find them difficult to keep, but if the water conditions are fine, then you should have no trouble.

A newcomer to consider

One of the newer 'kids on the block' which looks absolutely fantastic in a shoal is the Colombian tetra, although hesitation is needed in this case when deciding on the correct scientific name. It was originally identified as *Moenkhausia colombae*, and then as *Hyphessobrycon ecuadoriensis*, although some suggested that it might be better described as an *Astyanax* species. Even more recently, it has been named as *Hyphessobrycon columbianus* which seems more appropriate, apart from the fact that the specific name is spelled incorrectly, based on its country of origin. With a typical tetra shape, it is the fish's colouration that generates most interest and looks stunning when seen in a well-planted aquarium with a dark substrate, particularly if there is some side-lighting through the front glass. The bright blue along the top half of the body contrasts so well with the vivid red caudal fin, set against the yellow anal and dorsal fins.

Red phantom tetra. *PHOTO COPYRIGHT PHOTOMAX AT THE GOLDFISH BOWL, OXFORD.*

Colour choice

How do you like your shoals, red or black? The choice is yours as, in typical car salesman mode, I can offer almost identical models in either colour! The phantom tetras come so described – there's *Megalamphodus melanopterus* (the black version) and *Megalamphodus sweglesi* (red). Again, they have a typical tetra shape, and in these cases, the body colours are, depending on species, either pink-red or a dusty grey-black. Both species display a black shoulder blotch and the single fins are solid colours, matching the respective body colour. The dorsal fin has a black patch but this is obviously far more noticeable on the red species!

An African option

Away from South America, another strong contender for the most popular shoaling species has to be the Congo tetra (*Phenacogrammus interruptus*). This really is a candidate for that long tank you might have, as it delights in swimming up and down with its companions.

The iridescence blue-green and gold colouration along the flanks of the male cannot be bettered when seen with beneficial side-lighting. Add to this the wonderful fin extensions that the male acquires when adult, and you can understand why this fish has remained such an popular aquarium favourite for so many years.


A wels catfish

A couple of cryptic mega-catfish?

Catfish come in various sizes, but two of the most intriguing cases of mystery freshwater fish may well involve still-unidentified catfish of quite prodigious proportions, as revealed here by **Dr Karl Shuker**.

Move over Jaws – here comes gums!

In 1925, one of the world's most famous explorers, Lieutenant-Colonel Percy Fawcett, mysteriously vanished while exploring the vast uncharted jungles of Brazil. Before his tragic disappearance, however, he had penned a fascinating account of his travels in this remote and dangerous area.

This account was ultimately published in 1953 as *Exploration Fawcett*. It contains brief descriptions of several mystifying creatures, including various dinosaur-like reptilian beasts, and a large, black dog-like cat (or cat-like dog?) called the *mitla* - but none is more intriguing than a supposed giant toothless shark.

According to Fawcett, the Paraguay River contains: "a freshwater shark, huge but toothless, said to attack men and swallow them if it gets a chance". In reality, however, very few sharks inhabit freshwater, and those that do are far from toothless. So if such a shark really does exist, it is dramatically different from anything currently known to science. However, it may not be a shark at all.

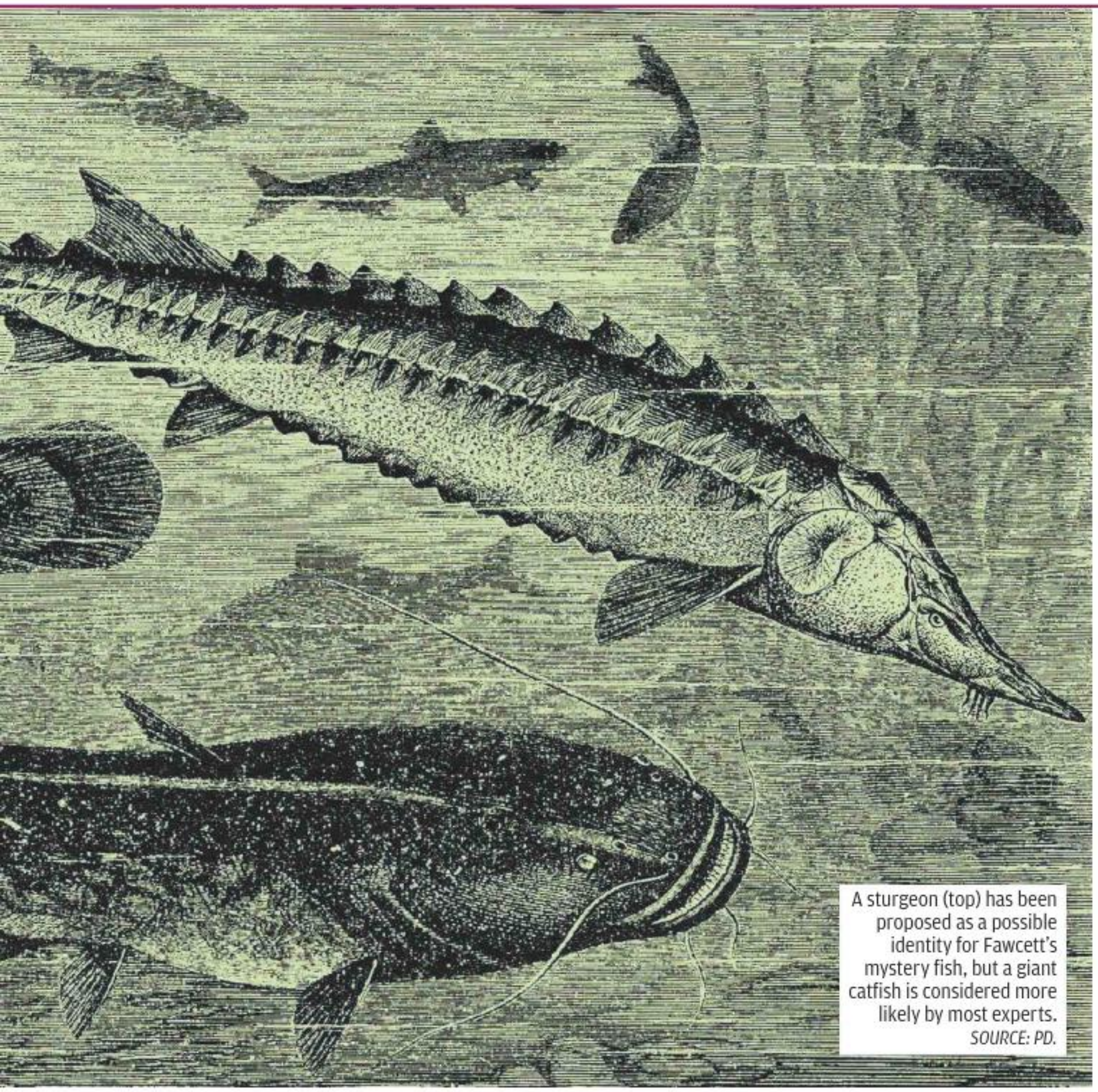
LEFT Richard Svensson's model, based on description of the so-called whale-fish. *COURTESY RICHARD SVENSSSON.*

Mistaken identity?

British cryptozoological researcher Mike Grayson has suggested that it could be a very large sturgeon. Some species are vaguely shark-like and are known to be capable of attaining great sizes. However, he concedes that this is a very tentative identification, acknowledging that sturgeons do not attack and swallow people, and that there is no known species of South American sturgeon to act as a geographical precedent anyway.

In my opinion, a catfish identity may be the more plausible explanation in this case. More species of catfish exist in South America than anywhere else in the world, and some of these particular species are among the world's largest too. In addition, Europe is home to the giant wels catfish (*Silurus glanis*), which, although typically growing no longer than 2m (6.5ft), may possibly attain lengths of up to 4m (13ft) and has often been accused (unjustly or otherwise) of swallowing people. Yet even if this latter aspect is based on folklore rather than fact, the concept of a giant catfish existing in South America is certainly not impossible.

Of course, catfishes usually possess teeth at least on their vomer bone in the mouth. However, old specimens of some species are entirely toothless - as in, significantly, the case of the giant *pa beuk* (*Pangasianodon gigas*) of southern Asia's Mekong River. Up to 3m (10ft) long and reputedly even longer in rare cases, it is the world's largest species of fish confined entirely to freshwater. Yet amazingly, the Mekong giant catfish



A sturgeon (top) has been proposed as a possible identity for Fawcett's mystery fish, but a giant catfish is considered more likely by most experts. *SOURCE: PD.*

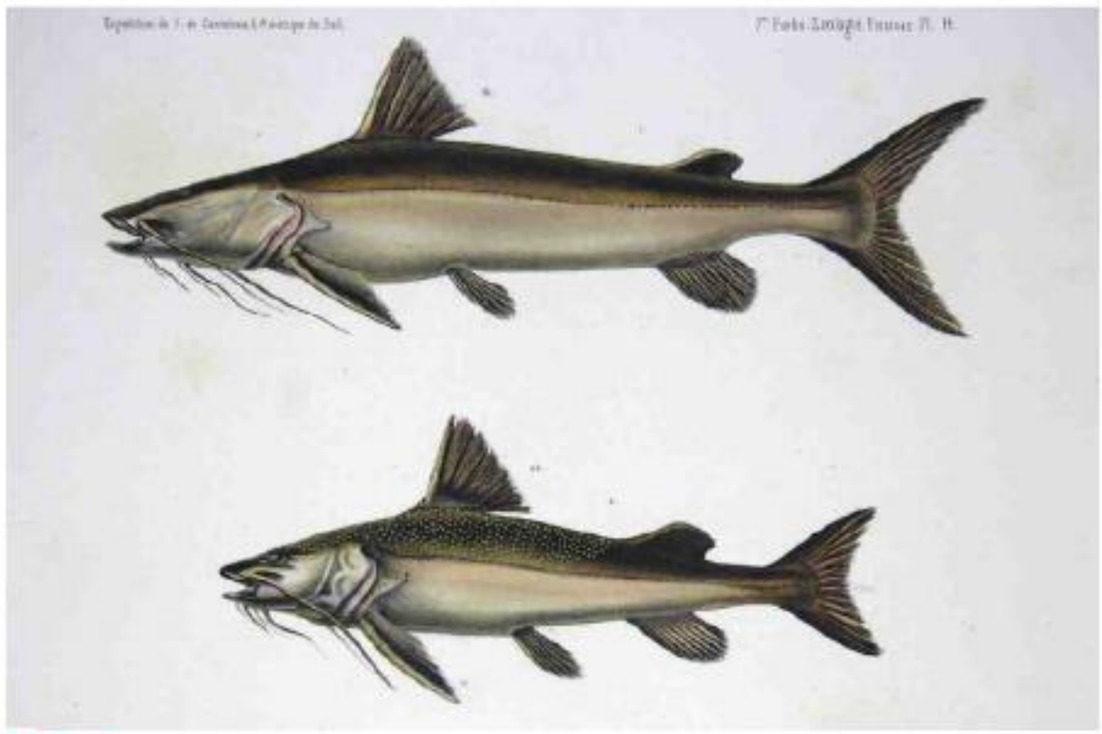
remained undiscovered by science until as late as 1930.

Moreover, unlike most catfish species, this gentle but nowadays highly endangered giant is strictly vegetarian. So perhaps Fawcett's huge, toothless, so-called shark - aptly dubbed 'Gums' by Grayson - was really an elderly catfish without any teeth at the front of its mouth, belonging to a still-undescribed extra-large species?

An equally interesting alternative identity, suggested to me by German cryptozoologist Markus Bühler, is confusion with South America's piraiba (*Brachyplatystoma filamentosum*). This huge Amazonian species of goliath catfish has a deceptively shark-like body outline, and it is already known to grow up to 3m (10ft) long and weigh up to 200kg (440lb). So who knows, reports of 'Gums' may have been based upon sightings of exceptionally large, geriatric piraibas?

Sadly, however, no further reports of any mystery fish directly linked with descriptions of Gums have apparently been recorded since Fawcett's time. So at present, its very existence remains officially unconfirmed, let alone its taxonomic identity.

The mystery surrounding Lieutenant-Colonel Percy Fawcett's disappearance will probably never be solved. *SOURCE: PD.*



ABOVE It is possible that the piraiba, with its shark-like profile, could provide an explanation for Fawcett's giant, tootless shark. *SOURCE: PD.*

The whale-fish of Lake Myllesjön

Since at least the middle of the nineteenth century, rumours have been circulating of an enormous water beast dubbed the whale-fish that is said to inhabit the cool, deep waters of Lake Myllesjön in the southernmost Swedish province of Blekinge. Yet were it not for Blekinge-based cryptozoological artist Richard Svensson, this freshwater cryptid would probably have remained entirely unknown beyond Sweden's perimeters.

Happily, however, Richard generously permitted me to include information gathered by him (plus a detailed line drawing prepared by him) within my book *Mysteries of Planet Earth* (1999), which finally brought this fish to international attention. More recently, Richard has also very kindly sent me a whale-fish model designed and produced by him, which is depicted here.

A flurry of sightings occurred during the 1920s and 1930s, including one featuring a huge fin-crested back rising above the water surface. Another observer claimed to have seen a whale-like creature frolicking at the water's edge, and local fisherman Sven

TURN OVER FOR MORE FISH MYSTERIES »

Wels catfish can grow to a huge size, even in relatively cold waters as in Sweden. *SOURCE PD.*

Johan discovered two of his fishing nets torn apart after hauling them out of the lake.

One eyewitness, while riding by the lake on his bike, saw what he initially thought to be a massive log - until the water surrounding it began to churn, and the 'log' abruptly dived out of sight. Moreover, three girls fled screaming in terror after seeing what they likened to a whale basking in shallow water near the lake's shore.

The search begins

Following this last-mentioned incident, an official plan of action was drawn up and set in motion. As Richard revealed in an account that he sent to me, this is what was decided at that time, to investigate the mystery of the monster:

"The local blacksmith made a hook the size of a ping-pong bat, a piece of board was made as a float, and a steel wire chosen as line and tied around a slim oak tree. A butcher donated a dead piglet for bait, and the entire contraption was hurled out into the lake.

"The next day, the oak tree was found uprooted, bobbing about in the middle of the lake, where it stayed for a whole week until it sank. Nothing more happened and the monster was believed to be dead."

Further sightings

During August 1962, however, events suggested otherwise, with several stories hitting the Swedish headlines of huge 'logs' splashing in the lake. This time, however, the local response was to unleash a veritable hunting party in the monster's wake, consisting of 425 fishermen - each one competing against all of the others not only for local fame, but also for the financial recompense of 1000 Swedish kroner (£100), should they hook the beast.

Perhaps, however, it was a case of too many anglers spoiling the lake, because the biggest fish caught was a very unremarkable perch weighing just 1.3kg (3lb). Undaunted, however, attempts to capture Myllesjön's elusive whale-fish continued apace. Quoting once again from Richard's account to me:

"In November 1962, several large hooks were manufactured and baited with dead chickens and calves' heads. Most newspaper stories say that the efforts went resultless, but others claim that at least one of the calves' heads disappeared. During 1963, the diving log was seen again, and in September another fishing competition was held: now with the prize of 10,000 Swedish kroner (£1000). Again, it proved to be an uneventful event."

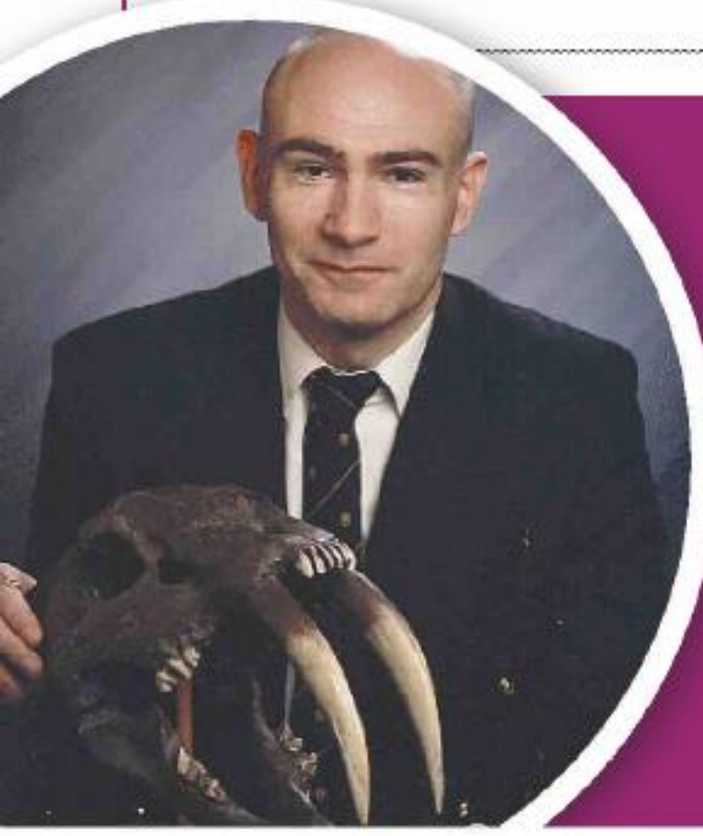
Richard has learnt of reports as late as the 1970s, but when he visited the lake in 1996, he was horrified to discover that a sizeable motorway had been constructed right next to it, and that people living nearby were no longer familiar with reports of the whale-fish. This suggests that even if such a creature had indeed existed here in the past, it no longer does so, with its disappearance perhaps being linked to the motorway's construction.

A possible explanation

Richard and I agree that the apparent whale-fish of Lake Myllesjön was probably a giant wels catfish. This may also provide the explanation for accounts of a similar creature in another Swedish lake. Richard states that the largest confirmed specimen of a wels catfish ever caught in Sweden, way back in 1871, measured a mighty 3.5m (11.5ft) long. Interesting, indeed, that even in the relatively familiar landscape of Sweden - far removed from the remote, jungle-infested realm in which Lt-Col. Fawcett disappeared without trace all those decades ago – very large, scientifically unrecognised fishes have still been witnessed in modern times.

DID YOU KNOW?

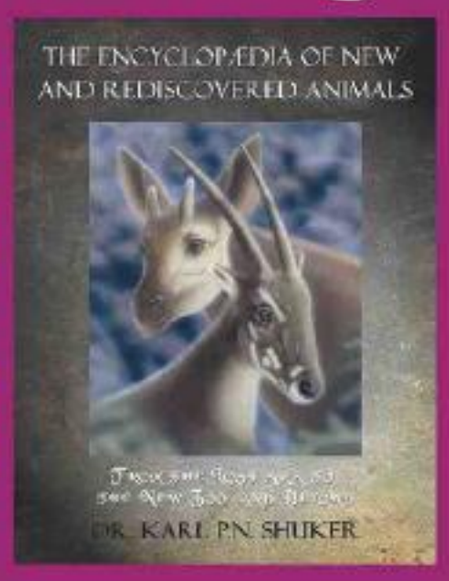
The wels catfish has an extensive range. Blue shows where this species can be found in coastal waters; red areas show its inland range and orange reveals localities where it has been introduced. *MAP COURTESY CYMOTHOA EXIGUA, BASED ON UWE HARTMANN: SÜSSWASSERFISCHE (ISBN 3-8001-4296-1) AND ROLAND GERSTMEIER, THOMAS ROMIG: DIE SÜSSWASSERFISCHE EUROPAS FÜR NATURFREUNDE UND ANGLER.*



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.

KEEP YOUR FISH SAFE

The potential hidden killer

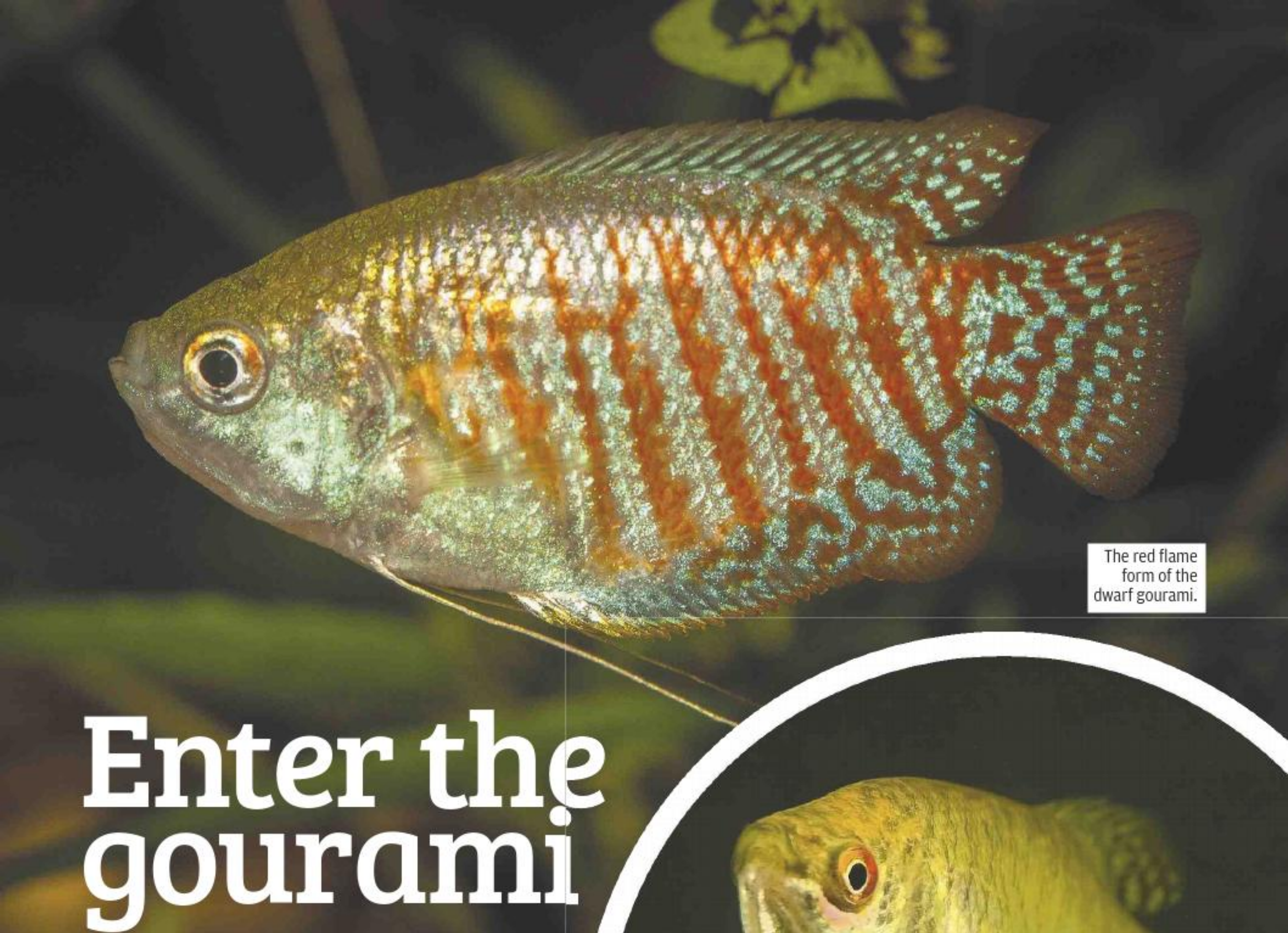
It is not safe to use water straight from the tap for your aquarium. **Greg Jennings** explains the dangers.

You need to keep your fish safe from the chlorine-based compounds that are added to tap water. These are present to make drinking water safer, but unfortunately, both chlorine and chloramine are toxic to fish, even in minute quantities. As a guide, most water supplies have a chlorine level of 0.2-0.5mg/litre, but as little as 0.1mg/l may be sufficient to harm fish. Chloramine is even more toxic to fish, representing a combination of chlorine and ammonia and it will also take significantly longer to come out of solution. The active agent that affects fish is known as hypochlorous acid, formed by a combination of chlorine and water molecules. Fish exposed to tap water that has not been treated to remove chlorine will display obvious signs of distress, swimming around wildly at first, with the aim of escaping from the poison.

Before long, in the confines of an aquarium, their colour will start to fade, and they display a behaviour called shimmying. They will stay in one place and vibrate their bodies – rather as we do when we shiver. Ultimately, their breathing becomes affected, although those fish that can utilise atmospheric air directly, such as corydoras catfish and labyrinth fish, are somewhat less vulnerable to chlorine poisoning.

It is very easy to neutralise chlorine though, and keep your fish safe, simply by using a water conditioner to treat tap water, before adding it to the aquarium. Such products usually have the additional advantage of helping to reinforce the protective mucus barrier that covers the fish's body, helping to protect against fungal diseases and other infections.

This barrier can be accidentally damaged when you catch a fish, so making it more vulnerable. Be especially careful for this reason if you ever need to handle a fish directly (which is not generally to be recommended). Always wet your hands with dechlorinated water first, so the protective mucus will then be less likely to come off on to your skin than if your hands were dry.



The red flame form of the dwarf gourami.

Enter the gourami

Domestication has seen the emergence of various colour forms in these fish.

Tropical freshwater fish can come in all colours and sizes, but the gouramis represent a group that has been popular with aquarists not just in their Asiatic homeland, but further afield too, for more than 400 years. **Christian Castille** reports on why these fish are so popular, and what appeals to him about keeping them.

My first experience of keeping gouramis goes back to when I was a child. I used to have dwarf gouramis (*Trichogaster lalius*) in some of my freshwater tanks. These fish still rank amongst my favourites – and I am not alone! They are definitely amongst the most iconic of gouramis, being chosen to appear on packs of fish food and book covers, as well as used in more general advertising too.

They are always listed as one of the recommended fish for people new to the fish keeping hobby, and with justification. Thanks to their hardy and social nature, plus their very bright colouration, they are fantastic fish to keep as part of a community aquarium. I have to confess – they can also be addictive! Keeping these gouramis led me into fish keeping on a larger scale, and also encouraged me to breed many other different species of gourami as a result. Even today, I still keep nine distinct species of this group of anabantoid fish.

Confusion over names

The first thing to remember about these fish is they are not – strictly speaking – an actual fish but a type of fish. This can be confusing, especially if you're new to the hobby, but basically, gouramis are not a group recognised in ichthyology – the science of studying fish. Instead, their collective name is a category used by hobbyists and those in the aquatic trade.

Closely-related species from different genera feature in this group. So unlike the Siamese fighting fish that I wrote about in our previous issue, belonging to the genus *Betta*, there are multiple genera described as gouramis, including *Trichogaster*, *Macropodus* and *Ctenops* – not forgetting

the *Betta* genus too!

It has been suggested that there are currently about 96 species belonging to 16 genera that could broadly be described as gouramis. But this is an underestimate, and the figure is likely to rise further in any case, because new species are still being discovered in genera that are popularly regarded as belonging to this group.

Common characteristics

For me personally, I don't regard bettas as being part of the gourami complex, but prefer to view them simply as part of the broader anabantoid group of fish. There are links between these various fish though – not least their geographic range, which is centred in south-eastern Asia.

Gouramis are nevertheless anabantoids. This means that they possess labyrinth organs in association with their gills, which allow them to breathe atmospheric air directly, and so survive in areas where the oxygen level in the water is low.

When it comes to scientific recognition, the tendency is for all members of the Osphroemidae family to be regarded as gouramis. Yet on the other hand, you then have species of fish that are named as gouramis but which, technically speaking, have no real links to other fish described under this name, apart from being included in the same suborder Anabantoidei.

These fish are linked simply on the basis of their ability to breathe air, even if their lifestyles, as shown by the climbing perch for example, are different. On the other hand, the kissing gourami (*Helostoma temminckii)*, the only member of the Helostomatidae family, is actually much more closely related from a hobbyist's point of view to that of members of the Osphronemidae family. As I said, it can be confusing!

DID YOU KNOW?

It is often said that the description 'gourami' is a plural form, but even so, hobbyists generally add an 's', with 'gouramis' being widely-used for this purpose.

A giant gourami - the largest member of the group.

The founder of the family

In 1859, Pieter Bleeker was serving as a doctor in the Dutch army, based in Indonesia. When he was not on duty, he would go out in search of fish, discovering new species and collecting as many as he could. While stationed there, he built up an extensive collection, which, combined with the other fish that were being discovered around this time, led him to propose the creation of the family Osphronemidae, for these various air-breathing fish.

During his time in Indonesia, Bleeker collected an impressive array of over 12,000 specimens of fish, which now form part of the collection of the Natural

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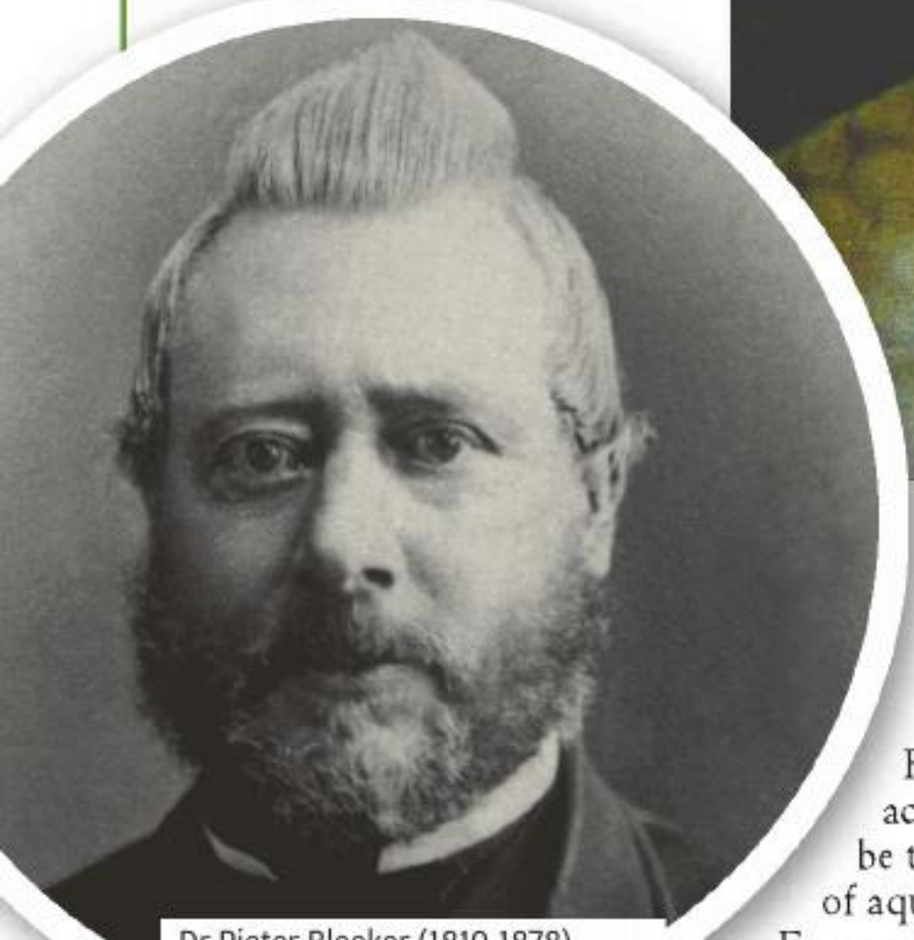
"Keeping these gouramis led me into fish keeping on a larger scale, and also encouraged me to breed many other different species of gourami ."

History Museum in the Dutch city of Leiden. Believe it or not, he was responsible for discovering 511 new genera of fish, which included 1,925 species of fish previously unknown to science.

Aquarium care

The paradise gourami (*Macropodus opercularis*), described in 1758, was the first gourami to be classified, by Carl Linnaeus, the most prolific taxonomist to have ever lived. These were described by careful studies



Dr Pieter Bleeker (1819-1878), who was a pioneer in the study of Asiatic freshwater fish – including gouramis. Photo courtesy Holthuis collection, Naturalis.

of fish that had been collected and sent to the museum. Yet there is an interesting story that suggests this species may have been seen and kept in England almost a century earlier.

During 1665, the famous diarist Samuel Pepys wrote about "A fine rariety, of fishes kept in a glass of water, that will live so forever, and finely marked they are, being foreign." This description is believed to refer to a pair of paradise gouramis brought back on board a ship belonging to the East India Company, from China. Furthermore, Pepys' account is believed to be the first description of aquarium fish in Europe.

Paradise gouramis became more widely available in 1869, thanks to Pierre Carbonnier, who was a French farmer and director of the Aquarium du Trocadéro. He asked a friend, serving as a soldier in the French army, if he would collect a shipment of fish for him from China. This consisted of a number of paradise fish, of which 22 specimens survived the journey back by sea, and they subsequently bred later that year with great success.

Keeping members of the gourami group in aquariums therefore has a long history, extending back further than virtually any other group of fish. They were being kept in areas of their native range as long ago as the 1200s, and there are even some cave markings in Indonesia showing such fish, hinting at a much earlier association of this type.

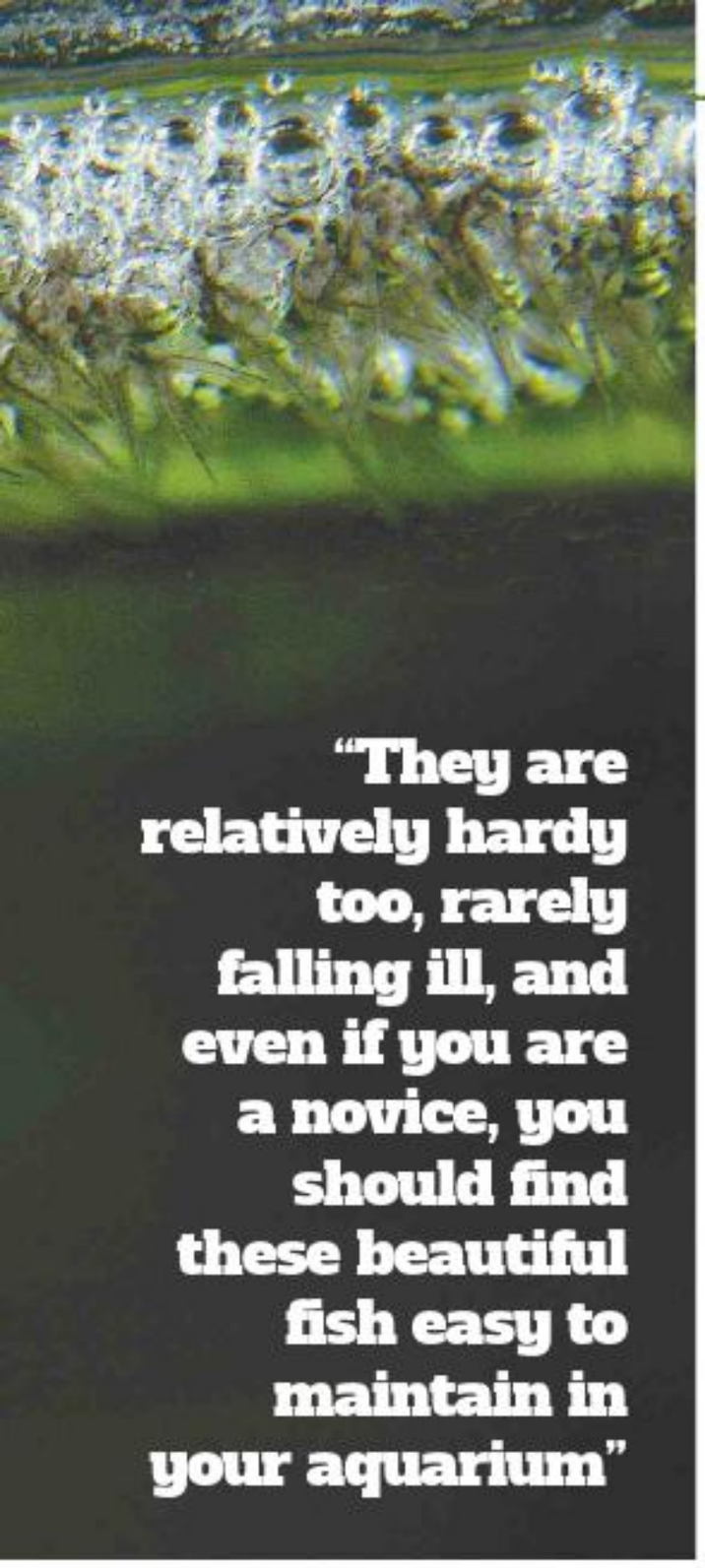
Their appeal

It is actually quite easy to summarise just why gouramis have become so widely kept as pets in the western world over the course of the last 160 years. This is simply because of their personality. I realise that I have just humanised these fish by this making statement, effectively anthromorphising the group. Yet to me at least, it seems true!

In many cases, gouramis will fight with related species if they are housed together, yet when you add them to a communal set-up, alongside other types of fish, they are generally much calmer. They appear to keep the equilibrium within the collection, while also becoming the central highlight of the aquarium in which they are displayed, never failing to draw the eye. They can swim fast if necessary, but prefer to move at a slow, peaceful pace.

Of course, these generalisations are not the case for every individual, but the relatively hardy nature

ABOVE The markings of the paradise gourami are very attractive.



"They are relatively hardy too, rarely falling ill, and even if you are a novice, you should find these beautiful fish easy to maintain in your aquarium"

of many species such as the paradise gourami also helps to explain why they are amongst the most sought-after of aquarium fish, particularly in the early days of the hobby, before today's sophisticated electrical equipment was available. I actually know some marine fish keepers who have reverted back to having fresh water tanks, simply because they missed keeping gouramis!

The following is a list of my personal favourites within the group. You do need to bear in mind that a few species will grow into potential tank-busters, and are not suitable for the typical aquarium, so as always, read up about those that interest you most, before acquiring them.

Pearl gourami (*Trichopodus leerii*)

This is an extremely peaceful species that has been kept and bred repeatedly in aquarium surroundings for many years. They are so-called because of their whitish, spotted patterning, which gives the impression of resembling miniature pearls. Sexing and breeding these bubble nest breeders is very straightforward, with males being much redder and have larger dorsal and anal fins than females.

These gouramis can grow to 10cm (4in), but are usually smaller in size, making them the perfect choice for a communal tank. They are relatively hardy too, rarely falling ill, and even if you are a novice, you should find these beautiful fish easy to maintain in your aquarium. Like other members of this group though, they should not be mixed with aggressive barbs in these surroundings, as these fish are likely to harry the gouramis, by nipping their fins. Separate the pair of gouramis into a separate spawning tank, for breeding purpose, where the water level is relatively low, and there are aquatic plants where the male can build a bubble nest, using his saliva. The female may lay up to 1000 eggs here, which hatch in a day or so, and then the fry will become free-swimming after a further five days.

Kissing gourami (*Helostoma temminckii*)

These fish are unfortunately often brought rather as a gimmick, because of the way that they will appear to kiss, rather than with any serious intent, which is a great shame as they are very rewarding to keep. Their so-called "kissing" may appear to be an affectionate gesture, but in reality, it is a trial of strength. It is often said that these gouramis are peaceful, but based on my experience and those of other people I know, they are not really suitable for community set-ups, proving to be rather stressful companions for other fish. Aside from their trials of strength, they will dig in the substrate for edible items, and may nibble at growing plants too. Kissing gouramis are not very easy to sex, except when females swell with eggs, but they do breed quite readily. They can grow to 20cm (8in) or more, and there are two distinct strains recognised. There is the silvery-coloured wild type, and a domesticated strain with pinkish colouration.

The kissing gourami is a misunderstood species.

White spots resembling miniature pearls are evident on the side of the pearl gourami's body.

Blue gourami (*Trichogaster trichopterus*)

This is another very popular species, which is rather confusingly known under a variety of different names in the hobby, including the three-spot gourami, although you are only likely to see two spots

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DID YOU KNOW?

Fish that build bubble nests generally inhabit areas of calm water, whereas those that are mouth-brooders live in more turbulent stretches where bubble nests would be swept away. This also impacts on the water quality needs of the fish, with bubble nest builders being more adaptable, whereas fast-flowing water prevents any significant build-up of impurities.

The appearance of these gouramis can change very quickly. The dark spots here are quite faint, being midway along the body and at the base of the tail.

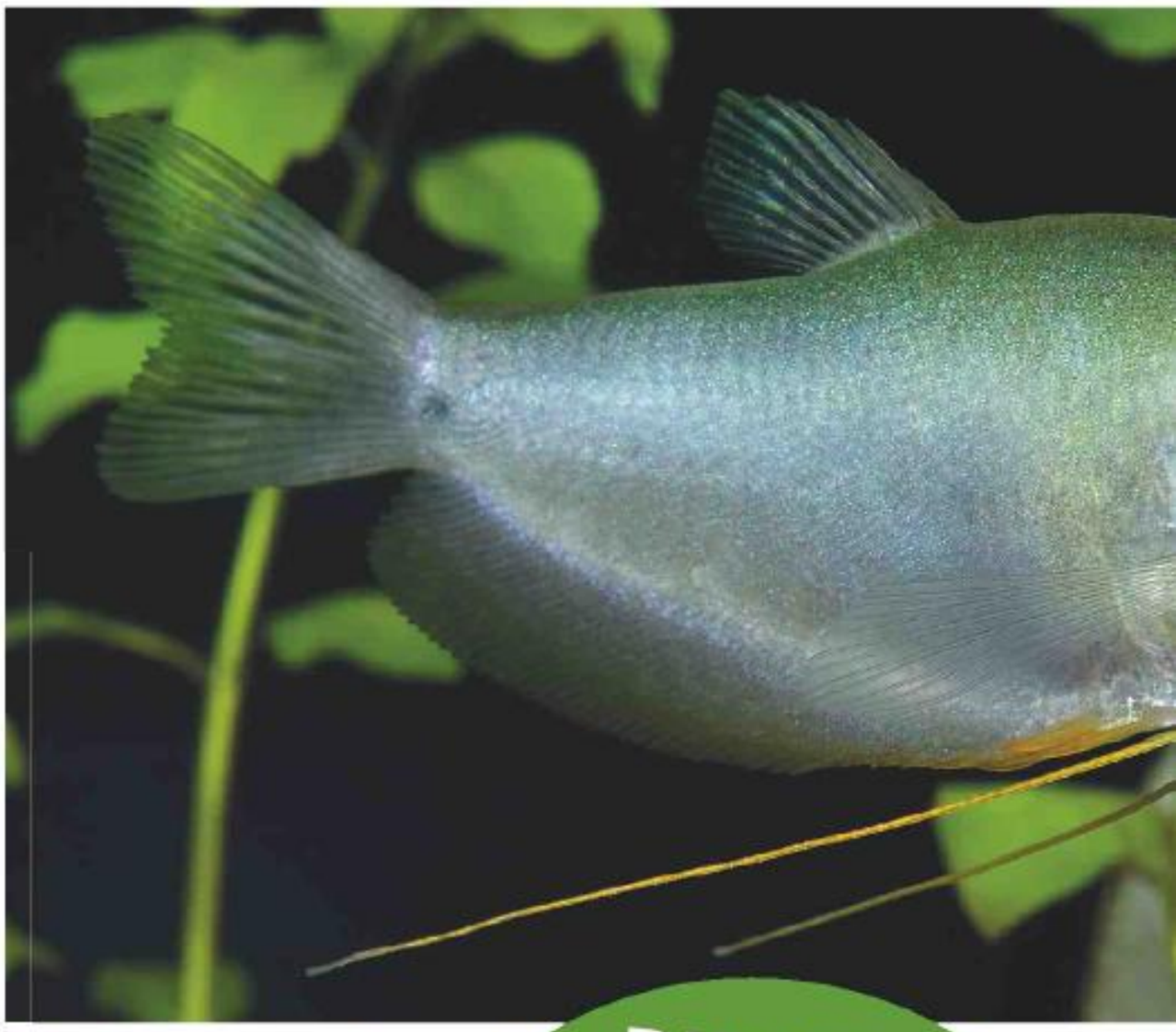
"Their colouration is quite variable too, being affected by their mood."

on each side of their bodies! This confusion arose because it appeared through the sides of the tank that they had three spots, with the third actually being their dark eye.

Their colouration is quite variable too, being affected by their mood. Even feeding them can trigger a rapid colour change. There are domestic colour variants as well,, including an attractive golden opaline shade, which shows to good effect alongside the wild blue type.

Once again, these gouramis are very adaptable, and can be recommended even for newcomers to the hobby. Males can usually be recognised by the elongated tip to the dorsal fin on the top of the body.

BELOW This particular gourami is one of the more demanding species, in terms of its care.



Chocolate gourami (*Phaerichthys osphormenoides*)

This gourami is one of my favourites although it does not rank amongst the most commonly available species, and their requirements are more specific too. They are more suited to aquarists with a few years of experience, partly

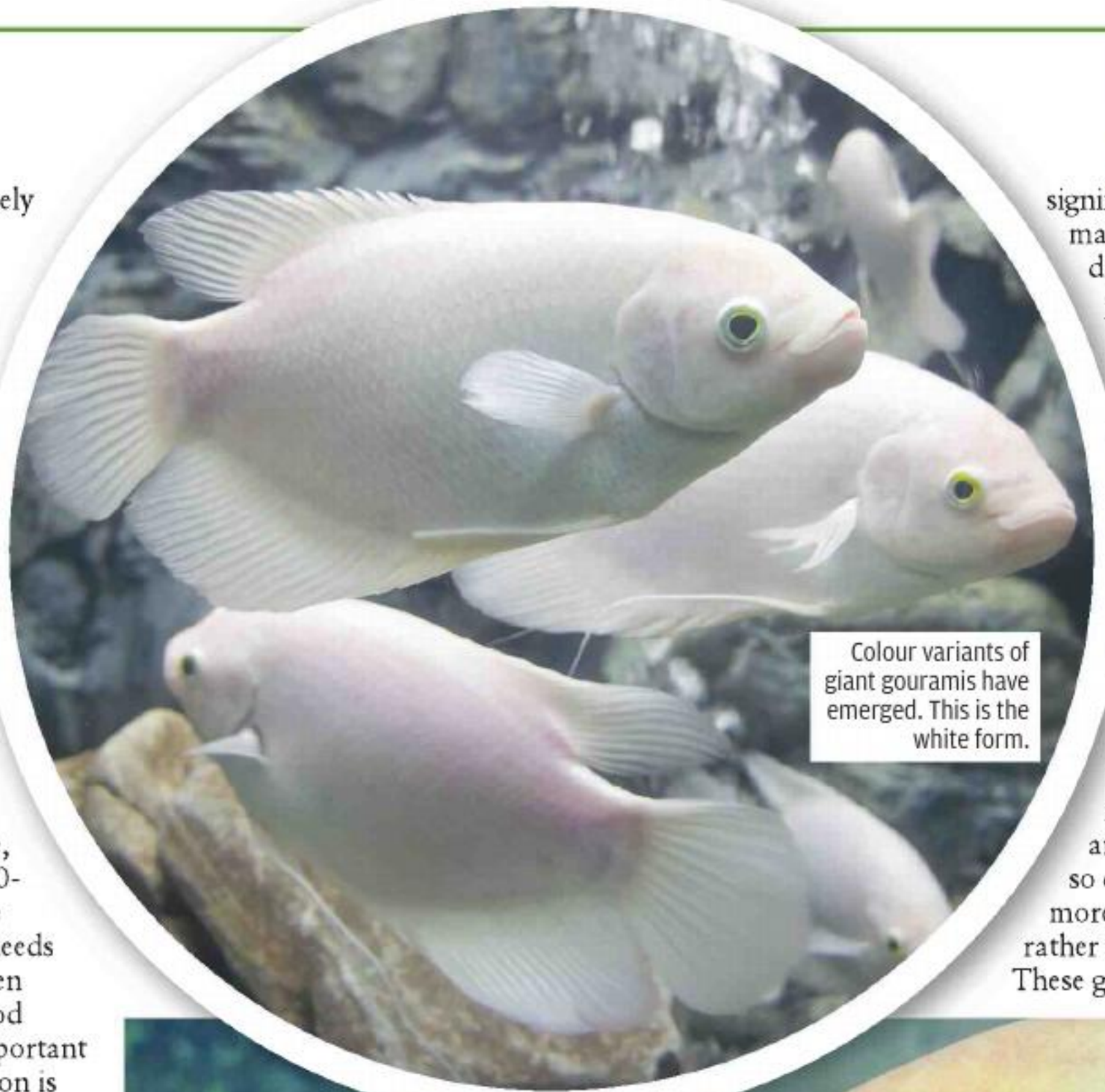
DID YOU KNOW?

One of the distinctive features of these fish is the way that their pelvic fins can be found right at the front of their bodies. These have become modified in shape too, assuming a hair-like structure. They are mobile as well, acting as feelers for the fish, enabling it to find its way around in murky waters where they are often to be found in the wild. Male gouramis are also thought to be able to use these adapted fins to detect chemical messengers, known as pheromones, released by a female when she is ready to spawn.

because these are relatively shy fish and prone to stress.

Chocolate gouramis can be kept as part of a mixed collection of fish, provided that you choose their companions with care. They can be accommodated safely with the likes of small, calm species of tetra, small plecs and corydoras catfish. Any fast-swimming fish are unsuitable though. Their water requirements are precise, with a pH reading of 6.0-6.5 being suitable, while the water temperature needs to be maintained between 27-30°C (80-86°F). Good water quality is very important too, and effective filtration is therefore vital.

Provided that the above



Colour variants of giant gouramis have emerged. This is the white form.

The scales of these particular gouramis are very small, with light reflecting off them.

Male giant gouramis of any colour will develop a nuchal hump on the head as they mature.

conditions are met, then there is nothing preventing these fish from being bred in aquarium surroundings. They are mouth-brooders, however, rather than bubble nest builders. Males can again be distinguished by having more elongated tips to their dorsal fins.

Moonlight gourami (*Trichogaster microlepis*)

A commonly-kept species, which benefits from quite a restricted pH range, between 6.0 and 7.0. Personally, these are not one of my favourite species, although their unusually small scales give them a distinctive and attractive shiny appearance. I found them rather dull, inactive fish, although they are easy enough to keep without difficulty.

Moonlight gouramis agree well with most species of fish, but they are very greedy, eating all types of food, which means that they will steal food from other tank occupants too. Also, they are not unlike large plec catfish, with a desire to dig up most plants in the aquarium.

Males have red pelvic fins and a dorsal fin that comes to a point. They are perfect fish for beginners to breed. Their lifespan can be very variable, extending anywhere from 5-10 years.

Giant gourami (*Osphronemus goramy*)

Not even remotely common in the hobby, but certainly obtainable, if you have the space to accommodate these giants. They can grow to 70cm (28in) in length. These are often exhibited in public aquariums and zoos, with some to be seen currently at Bristol Zoo.

Their appearance alters significantly as they mature. Youngsters display a narrow, pointed head with vertical body stripes, but as they grow larger, so their head shape becomes rounded. Males are very clearly distinguishable from females by this stage, developing a large nuchal hump on the head. They also have more pointed dorsal and anal fins, and so can therefore look more like a large cichlid rather than a gourami. These gouramis will prove to be extremely aggressive, especially the males which have multiple fighting techniques. These include mirroring the fighting styles of the Siamese fighting fish, as well as the more passive technique of dominance pursued by the kissing gourami.

They are not too easy to breed, largely because of their love for dark environments, meaning most tanks are not suitable. Their size too is another factor, but in Asia, they are widely kept in ponds and farmed for food. When

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spawning, females are prolific, and may produce up to 20,000 eggs at a time.

There can be confusion between the giant gourami and the little giant gourami (*Colisa fasciatus*), which, as its scientific name reveals, belongs to an entirely different genus. The species is significantly smaller, growing to a maximum size of only 10cm (4in). It is more colourful too, with variable red edging on the fins. Males are more colourful than females.

Snakeskin gourami (*Trichogaster pectoralis*)

I don't know if it is also because I am a keen breeder of reptiles – especially snakes – but when a friend brought me some of these fish some years ago, I automatically fell in love with them. I currently keep more snakeskin gouramis than any other species. They do, of course, derive their name from the distinctive and individual patterns that they exhibit on both sides of their body.

Snakeskin gouramis can come in a very varied range of colours and shades, thanks partly to the different areas of origin in parts of south-east Asia. They can grow anywhere from 15-20cm (6-8in) long, and are relatively hardy, being very suitable for both beginners and experts alike. These are very active fish that have straightforward care needs. In the wild, they occur in shallow waters, often being found in flooded paddy fields.

These gouramis are very easy to breed as well, and sexing is straightforward, with females displaying paler yellow rather than orange edging on their fins. Once the fry have hatched and are free-swimming, it can help to include an airstone, so as to ensure the tiny particles of rearing food are well distributed by the water currents, ensuring that they are freely available to the young fish.

The patterning of these particular gouramis is highly individual and is not symmetrical either, allowing individuals to be recognised easily.

Honey gourami (*Trichogaster chuna*)

This is another of my favourite gouramis. It is breathtaking in appearance, which helps to ensure its popularity. The colours of this gourami have been grabbing the attention for over 200 years, since its discovery. There are now two colour variants as well, notably the reddish-orange form, sometimes called the robin red or sunset, plus an intense yellow variety, called the gold.

Honey gouramis are also peaceful by nature and ideal for a community aquarium, providing that there are no fin-nipping barbs sharing their accommodation. Beautiful and peaceful - what more could you want in a communal fish? These gouramis are also easy to keep, and, as you may have guessed, they are easy to breed as well.

Being less than 5cm (2in) in size means they do well in most fish tanks. The only thing that you need to bear in mind is that males may fight with each other; however, females can be kept in shoals accompanied by a single male. These gouramis have identical care needs to those of the dwarf gourami, and can also be kept with them peacefully.

The honey gourami is beautifully coloured, and is easy to sex. Don't keep males together though.

PHOTO COURTESY SELF2.

In conclusion

This is just a few of the gouramis that are kept today. As you can see, the majority of them are easy to keep. They breed well, with their methods of reproduction, whether as bubble nest builders or mouth brooders, being fascinating to observe. They can really enliven a fish tank by adding a ripple of gourami energy into it! There are so many different types out there, so do some research into those that interest you and take it from there. Few types of fish have ever grabbed my attention in the same way, and I can't imagine fish keeping without them. I think they have earned their place as aquatic gems whose calm natures and beautiful appearance will always catch the attention of an observer.

Sunlight penetrates into water, being vital to the plants growing here.

How technology helps

Today, T5 lighting has become one of the most popular means of illuminating a freshwater planted aquarium. **Andrew Latham**, managing director at iQuatics Ltd explains more about this lighting system, and the increasing range of options that are now available.

Many aquariums on the market today are equipped with T5 lighting as a matter of course, and the majority of fish keepers will stick with this lighting, although sometimes, they may choose to upgrade to something like the iQuatics 6 tube T5 pendant. In this article, we will take a look at why the types of T5 tube used above your planted aquarium are so important, and the roles that they play in the photosynthetic response from your plants. We will also touch on which tubes you should be looking to use, and also the limitations of T5 lighting in planted aquariums. Let's start with the basics though, and get a better understanding of photosynthesis and how vital it is, using aquarium planting as an example.

Andrew Latham is at the forefront of aquarium lighting technology.

"The process of photosynthesis is considered to be amongst the most important biological processes on the planet"

What is photosynthesis?

Photosynthesis is a chemical process whereby aquarium plants produce glucose and oxygen from carbon dioxide while using only light as their source of energy for this purpose. Glucose is an energy unit that helps plants grow and survive, but exposure to the correct wavelengths of the light, approximating to those of sunlight, are vital to allow photosynthesis to take place.

The process of photosynthesis is considered to be amongst the most vital biological processes on the planet, because directly or indirectly, almost everything that lives depends on it at some point. If there were no plants, the food chains would break down, causing mass extinction. Within the context of an aquarium, inadequate

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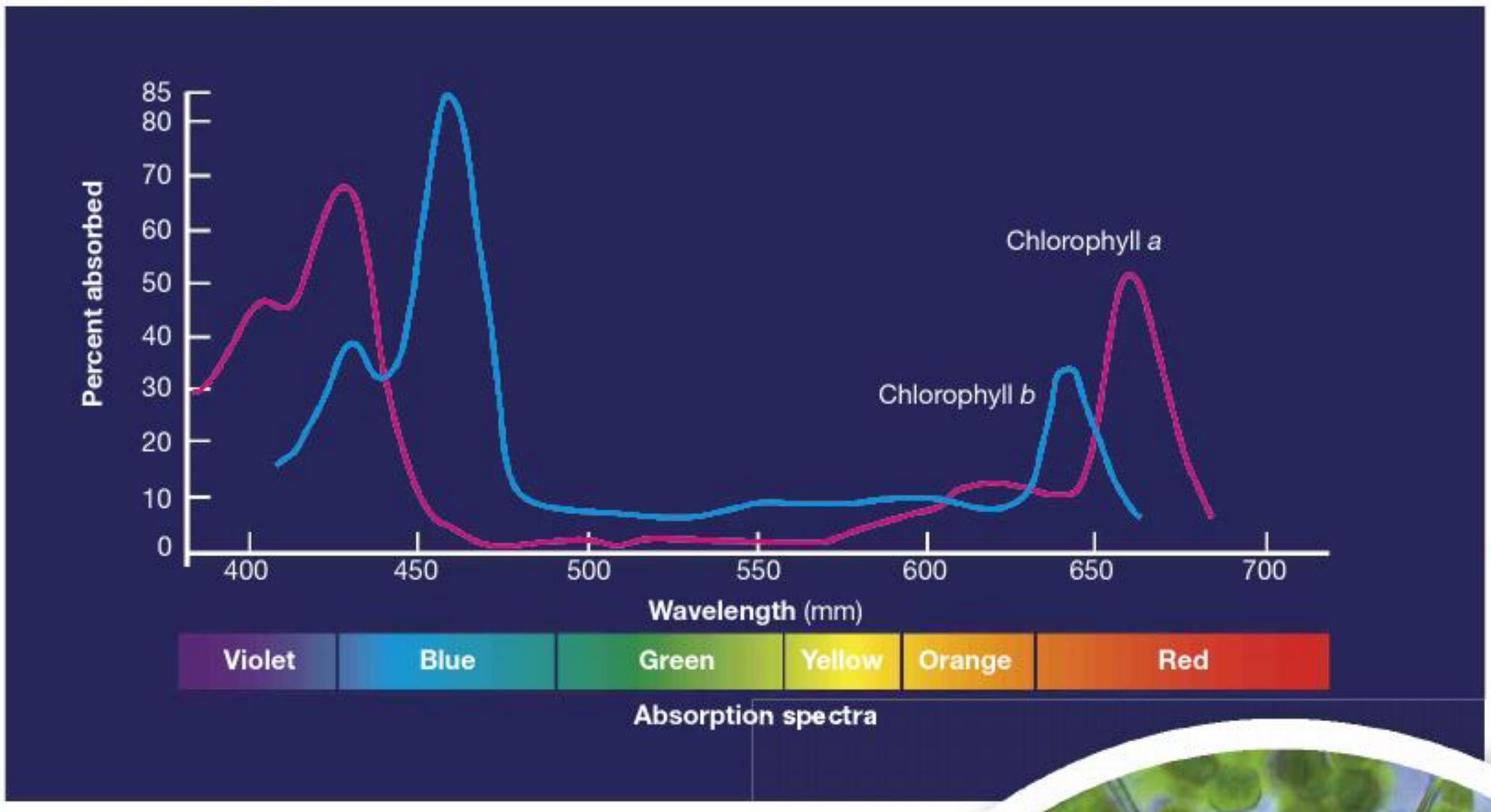
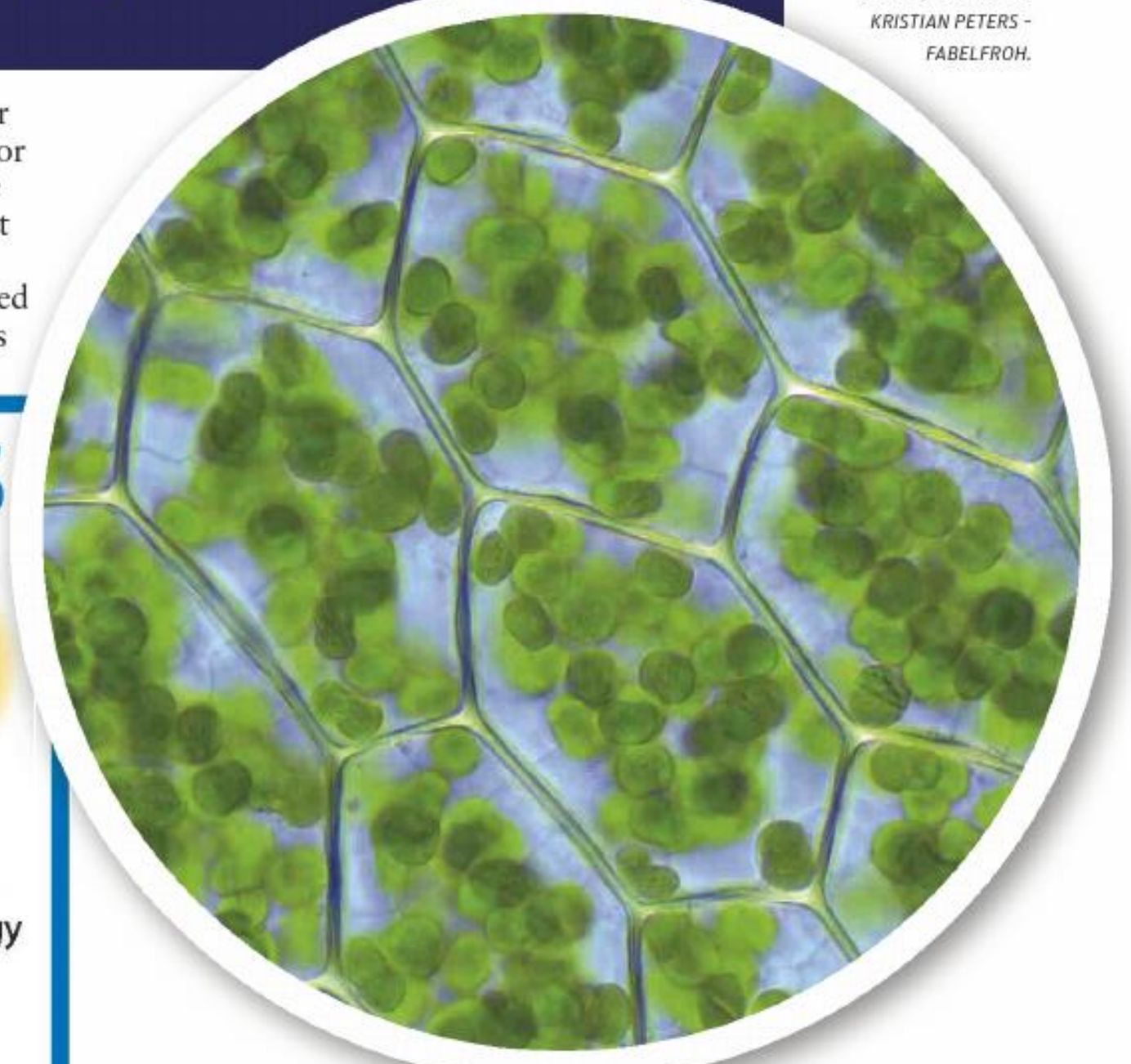
IMAGES OF LAMPS AND THE PHOTOSYNTHETIC DIAGRAM COURTESY IQUATICS LTD.



LEFT The peaks in this diagram correspond with the light output - measured in nanometres (nm) - that are required for effective photosynthesis.



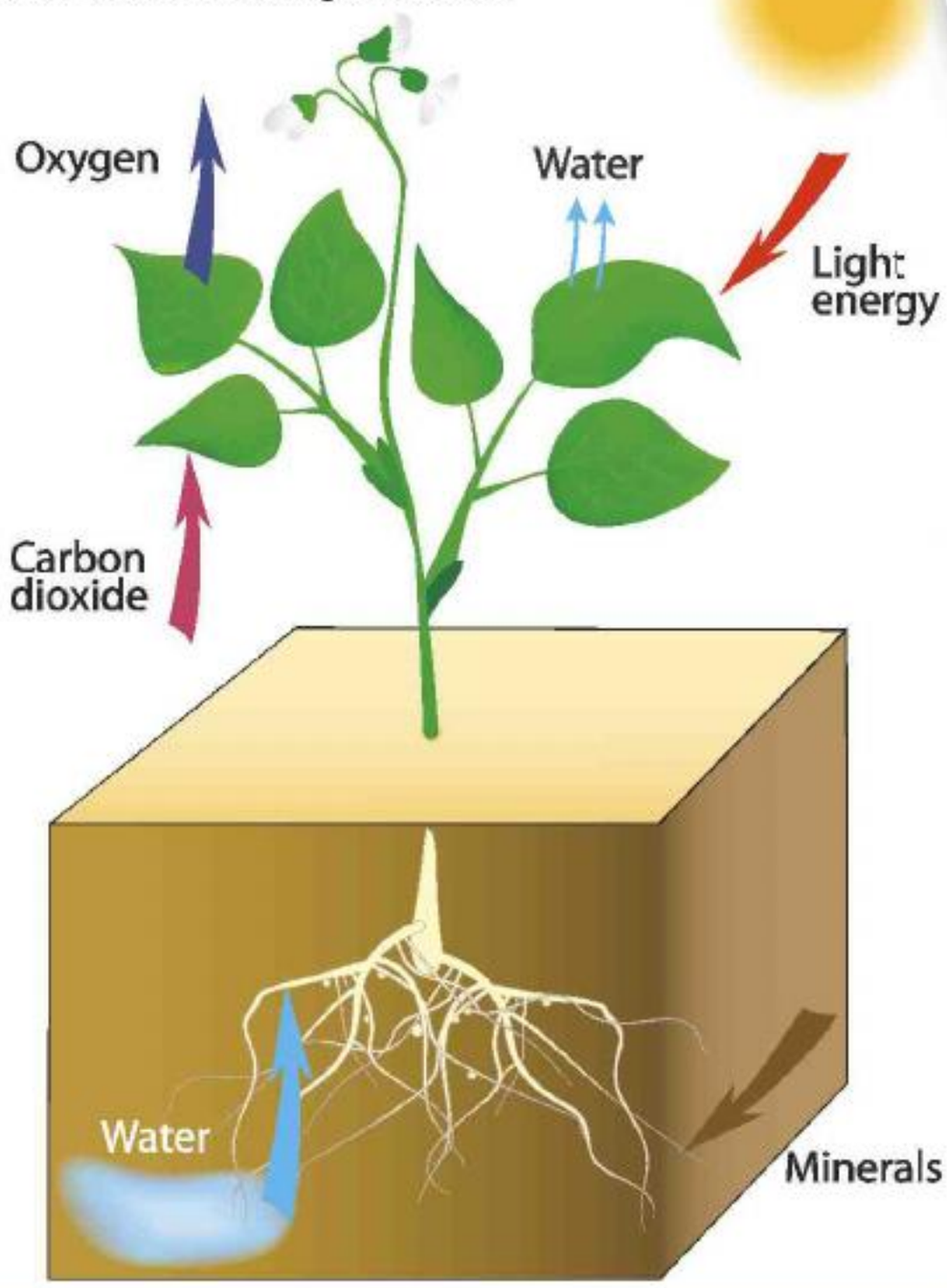
BELOW Chloroplasts visible in the magnified cells of the many-fruited thyme moss (*Plagiomnium affine*). COURTESY KRISTIAN PETERS - FABELFROH.

lighting will result in dieback of the plants.

Although the photosynthetic process can happen in different ways with different species, the key feature remains the same - the use of light to create sugar that can then be utilised for energy and growth by the plants. It is also significant because of the way that carbon dioxide is converted to oxygen by the plants as a by-product of this reactive process. If you look closely at aquarium plants under suitable lighting, you can sometimes even see bubbles of oxygen gas being released into the water.

PHOTOSYNTHESIS

Photosynthesis is vital for healthy plant growth, with a suitable artificial light source/s replacing natural sunlight in aquarium surroundings, in order to drive this biological reaction.



Why is photosynthesis important in the aquarium?

It doesn't matter if you have a tropical freshwater or a marine aquarium, plants and corals respectively both need to photosynthesise in order to survive and flourish. Without the correct source of light within the photosynthetic range of the colour spectrum (see above), then the process will not occur. This then means that the plants or corals that you have in your aquarium will not be able to create glucose and so are denied the crucial energy that they need in order to be able to survive and flourish.

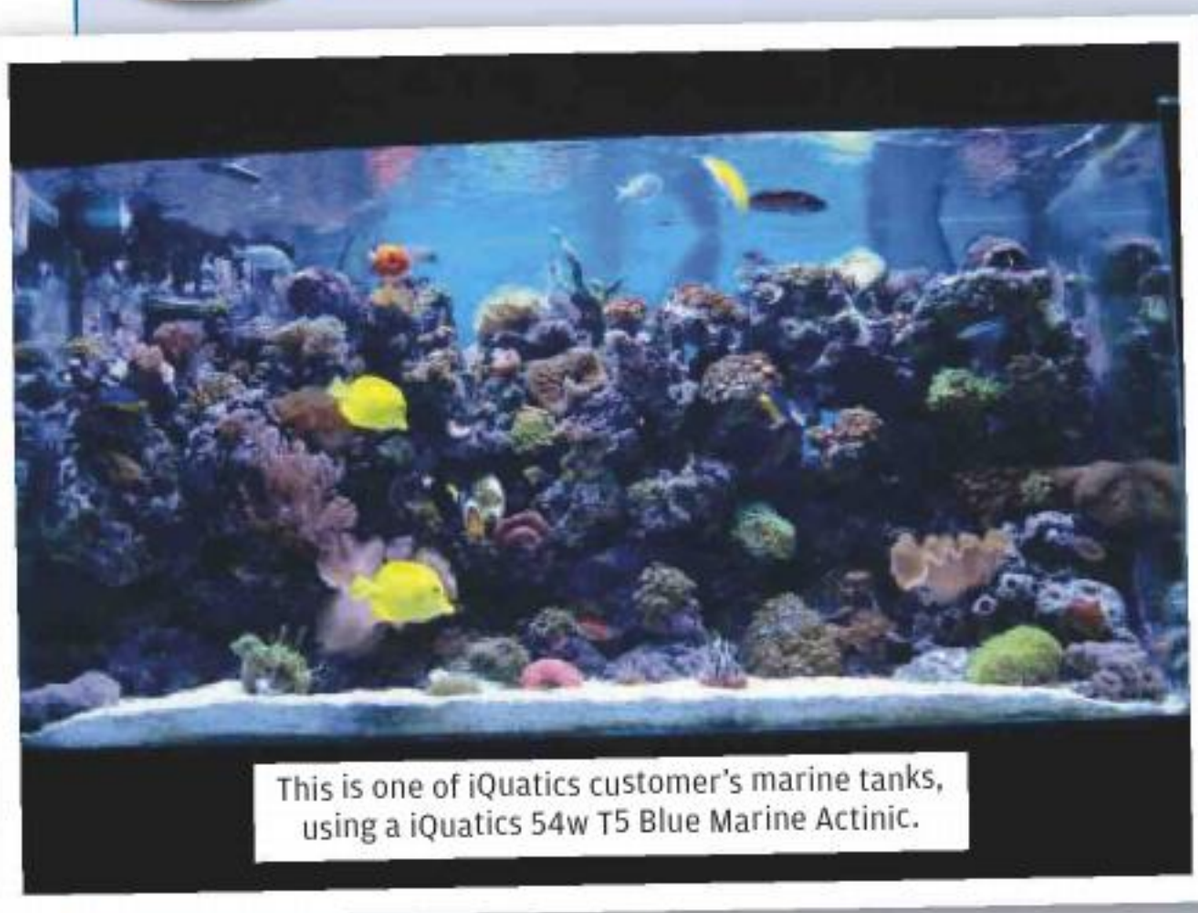
Chlorophyll a and chlorophyll b

There are two common types of chlorophyll that can be involved in photosynthesis, allowing the reaction to take place. Chlorophyll a

Popular Fish KEEPING

T5 lighting

The typical choice



This is one of iQuatics customer's marine tanks, using a iQuatics 54w T5 Blue Marine Actinic.

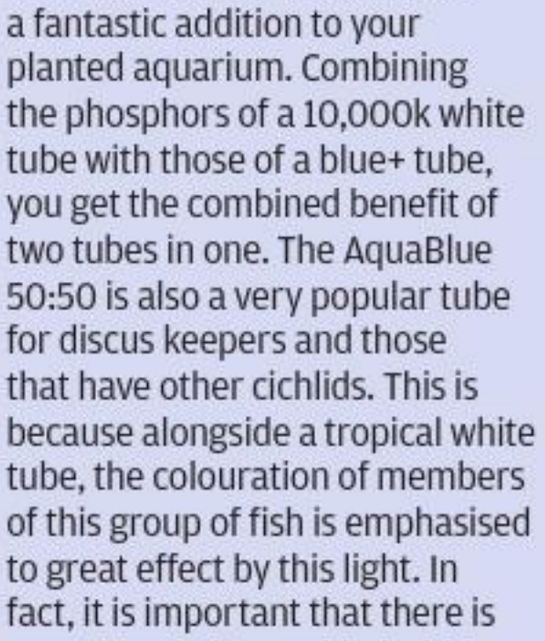
▲Tropical Tube

With a better understanding of photosynthesis and the vital role that it plays in plant growth, let's consider which T5 tubes will benefit the photosynthetic range of your plants to the greatest extent possible. Within the iQuatics range, the Tropical Tube is the one that is most widely used for planted aquaria. Having a Kelvin rating of 7500k, the light output of the Tropical T5 has been specially formulated to enhance the blue and red peaks seen in the chart, closely representing the wavelengths of natural daylight that are ideal for photosynthesis.

With a slight tint of pink, the natural colours of your fish will be enhanced too, while the perfect amount of green in the spectrum is present as well, in order to emphasise the natural colours in a typical freshwater aquarium. Ideal for the growth of plants that require higher levels of light, this bulb creates the appearance of a warm tropical tank.

▼A more specialised option

When selecting a blue light, it is important to get this correct, simply because the addition of too much light from the blue side of the spectrum in a tropical tank can trigger an increase in the growth of nuisance algae. However, when used correctly, the AquaBlue 50:50 can make a fantastic addition to your planted aquarium. Combining the phosphors of a 10,000k white tube with those of a blue+ tube, you get the combined benefit of two tubes in one. The AquaBlue 50:50 is also a very popular tube for discus keepers and those that have other cichlids. This is because alongside a tropical white tube, the colouration of members of this group of fish is emphasised to great effect by this light. In fact, it is important that there is some blue light provided within the spectrum of lighting used in a planted aquarium. If you can imagine blue light as the guidance system for all other light, then in its absence, so plants would not grow upwards towards the water surface, but will simply spread outwards in most cases. This can have the effect of drastically reducing the swimming area for the fish themselves, quite apart from adversely affecting the appearance of the aquarium.



▲The purple tube

This is the latest option! Not many people would think of incorporating a purple tube within the lighting system for a tropical aquarium. Yet when paired with a 14000k white bulb, we have found that the effects on plant growth can be fantastic, while the overall appearance of the light as far as the onlooker is concerned is similar to that of the iQuatics Tropical Tube.

▲Marine white 14000k

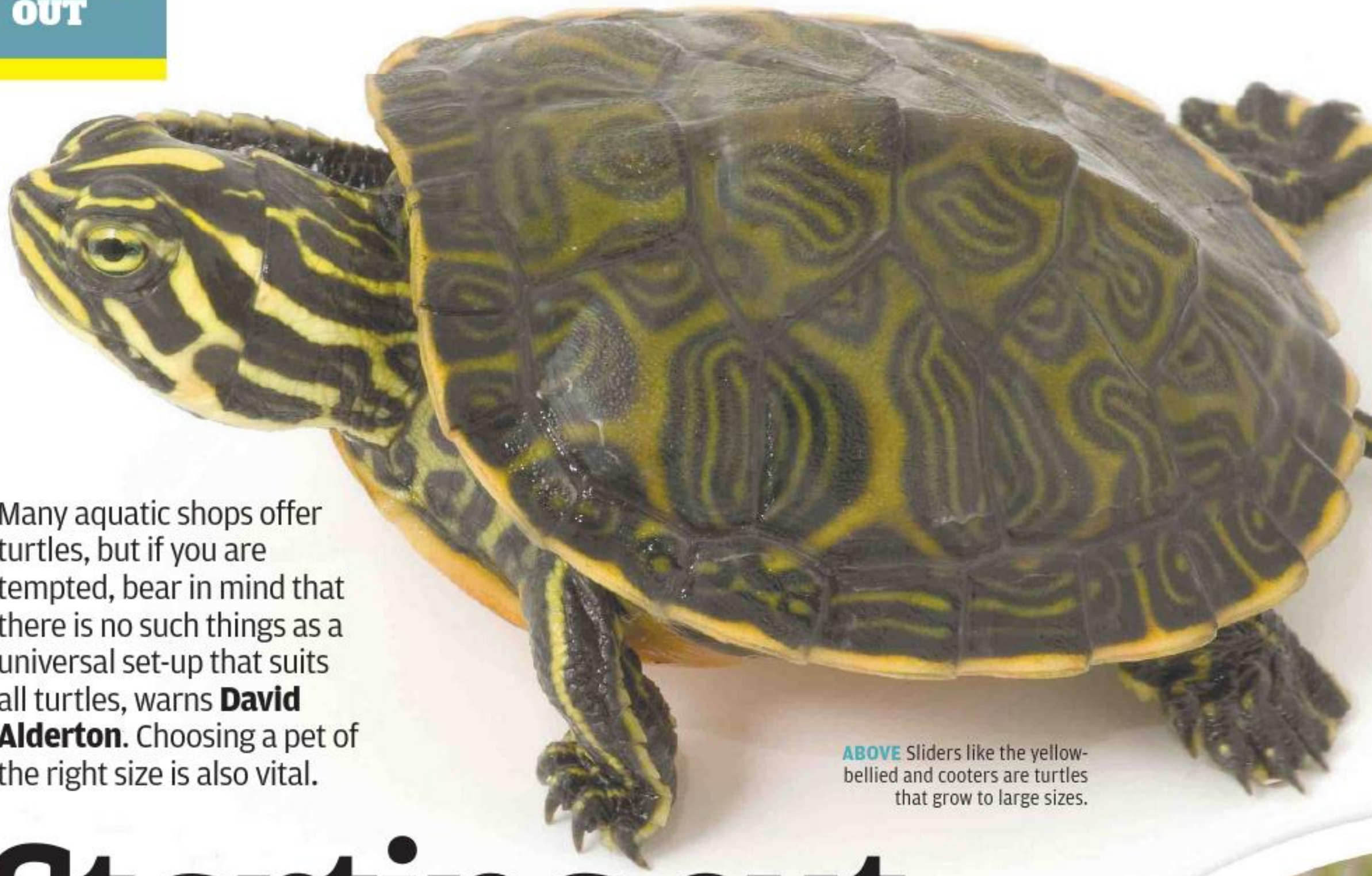
Don't let the name put you off! This is a full spectrum tube that offers a little of everything towards the overall lighting requirements of your aquarium. This tube is popular with those that prefer a whiter look rather than the warm daylight appearance offered by the Tropical Tube.

is the type of chlorophyll that is most widespread, being found in plants as well as red and green algae. It predominates in all cases, as with aquarium plants, with oxygen being released as a by-product of this chemical reaction. It is most effective absorbing wavelengths of light in the 400-450nm and 650-700nm part of the electromagnetic spectrum, as the peaks in the red line on the chart reveal.

Chlorophyll b is a yellow-green chlorophyll pigment that occurs only in plants and green algae. It functions as a light harvesting pigment that passes on the light excitation to chlorophyll a. It absorbs well at wavelengths of 450-500nm and 600-650nm of the electromagnetic spectrum, as shown by the peaks in the blue line. Within the cells of plants, photosynthesis occurs within specialised structures known as chloroplasts, where the chlorophyll is located. These cells are responsible for capturing the light energy that drives the process, and storing it.

The limitations of T5 lighting on planted aquaria

There is really only one thing that can make T5 unsuitable for use above your planted aquarium and it's something we come across quite often at iQuatics ..... the depth of water! We have had numerous conversations with customers who have just brought a 1.52x0.61x0.91m (5x2x3ft) aquarium for example, and want to use T5 lighting. Unfortunately, the light output from T5 tubes only has a beneficial penetration range of around 0.61m (2ft). It simply will not be effective for plants set in the substrate in deeper aquariums. If you chose a tank that measures more than 0.61m (2ft) in height, then you will need to consider halide lighting instead. Our advice is always to select the aquarium that fits in with your particular lighting requirements, bearing this key consideration in mind from the outset.



Many aquatic shops offer turtles, but if you are tempted, bear in mind that there is no such things as a universal set-up that suits all turtles, warns **David Alderton**. Choosing a pet of the right size is also vital.

ABOVE Sliders like the yellow-bellied and cooters are turtles that grow to large sizes.

Starting out with Turtles

Some turtles have specialised requirements, particularly in terms of their accommodation needs. This is something that you need to investigate carefully. It is also important to stress that turtles cannot be housed safely with fish in a home aquarium, as they are likely to prey on their companions.

Turtles can be fascinating to keep though, becoming remarkably tame, and they have a long lifespan too. Given the right environment, there is no reason as to why they should not even breed successfully in domestic surroundings. But bear in mind that a cute hatchling little bigger than a 50p

Softshells, like this spiny softshell, are a group of turtles with very specific needs.

piece can grow rapidly into a large turtle, ending up being the same size as a dinner plate. This applies in the case of many North American species, such as the yellow-bellied turtle (*Pseudemys scripta*) as well as snake-necks, and often creates housing difficulties.

Compatibility can also sometimes be an issue too, particularly with the soft-shelled species (*Trionyx* species). They seem to compensate for their lack of a hard protective shell by being particularly aggressive. It is very difficult to keep these turtles together within a relatively small enclosure, because the dominant individual will start bullying weaker companions. They must also have a sandy base in their quarters, where they can bury themselves. A low water level is equally important, so they can use their long noses like snorkels, while remaining hidden from above.

So which are the best species to start out with? The musk turtle (*Sternotherus odoratus*) and the razorback musk (*S. carinatus*) with its high ridged shell, are ideal choices, and young captive-bred hatchlings are often available, typically priced between £20-£30. Neither of these American turtles grows large - only up to about 15cm (6in), which means they are relatively easy to accommodate in the home. They also tend to be largely aquatic, and so do not require an extensive land area in their set-up.

Hatchlings are tiny, being little bigger than a thumbnail overall and significantly smaller even at this early stage in life than either cooters or yellow-bellied turtles. Pale creamy lines are evident running across the face and through the eyes, with the shell and limbs being quite dark in colour. The carapace - the upper part of the shell - is distinctly domed, with this appearance being quite normal.

Unlike sliders, which are so-called because of the fact that they spend regular periods out of the water, sunning themselves on river banks and logs in the water, and slipping (or sliding!) back here if they detect danger, musk turtles are more aquatic by nature. On the other hand, they are not such strong swimmers, and tend to frequent more shallow backwaters.

In fact, common musk turtles are often described

RIGHT Here is an indication of the difference in size between hatchlings and older sliders, as shown by these red-ears.

"Turtles can be fascinating to keep, becoming remarkably tame."

The common musk turtle has evident striping on its face.

Two red-eared sliders basking in the wild.

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as bottom-walkers, because of the way that they move when submerged, literally walking over the bottom of their quarters, while remaining on the look-out for potential prey. This behaviour needs to be reflected in the design of their quarters. The worst possible way of accommodating these turtles is how that they are sometimes displayed in aquatic shops, alongside tropical fish, in aquariums filled to the top with water.

Musk turtles should be kept in a tank where the water is relatively shallow. Gradually increase the depth as your turtle grows, so that the water is always just slightly deeper than the height of the turtle with its neck fully extended. The turtle can trot over the bottom, pausing as required to come up to the surface easily in order to breathe. In addition though, the substrate should be sloped, so one end, away from the basking area where the turtles can haul themselves out, is deeper than the other.

The relatively shallow nature of a set-up of this type means that the heating and filtration in the turtle's quarters may need to be rethought, with a heat pad under thermostatic control often being a more suitable at first, as a typical heaterstat must not breach the surface of the water when operating.

A typical power filter may also not fit easily into this type of set-up, as it too will need to be submerged. There is the possibility of accommodating an undergravel filter though, as often used in aquaria, but there will need to be a good layer of gravel on the floor.

Dirt is drawn down between the particles of gravel, with this layer acting as the filter bed. Over a period of time, beneficial bacteria build up here, and break down the turtle's waste. You can speed up this process by acquiring an aquatic product containing these bacteria and seeding the filter bed.

The key thing with this type of filtration system is to minimise the amount of waste in the tank, so as not to overload the filter, since this will lead to a fall-off in water quality, endangering the turtle's health. Skin and eye ailments are typical indicators of poor water quality under these circumstances.

Equipment

Start out with a large aquarium measuring 122cm (48in) long. It is false economy to buy a small set-up at the outset. This will only need to be replaced at additional cost as the turtles grow. There are plenty of designs of tanks and cabinets available, with those sold for fish keeping being ideal. You may also want to investigate the larger sizes within the Ferplast or Exo-Terra ranges of open-topped turtle tanks as an example.

For larger turtles, a heaterstat to regulate the water temperature will also be required, along with a heater guard. This will cover the lower half of the unit, and prevents the turtles from coming into contact with the heating element, and being burnt as a result. The water temperature should be set to about 26°C (78°F) and needs to be monitored with a thermometer. As a safety precaution, be sure to purchase a heaterstat that will automatically switch off if exposed to the air.

Coarse aquarium gravel can be used to cover the base. This will create an attractive appearance, but keeping tank maintenance will be harder, with dirt accumulating here. The regular use of a gravel cleaner, with an undergravel filter beneath, should help to ensure the tank remains clean and does not smell. Special bacterial cultures are available to mask any odour. Alternatively, you can opt for a bare base to the tank, and incorporate a power filter.

A razorback musk turtle. These two projections under the chin, described as barbels, have a sensory function. *PHOTO COURTESY LTSHEARS*

Musk turtles should not be kept in deep water, as they are not particularly powerful swimmers. This is a razorback musk, photographed in an aquarium.

A turtle largely hidden in duckweed in the wild. In an aquarium, the filter current will probably drive the duckweed to one area of the tank.

A special floating landing station that adjusts to the height of the water may be added too, allowing the turtles to leave the water easily, although a larger basking area can be created by securely-placed rockwork, with full spectrum lighting being essential above the land area of the tank. This helps to ensure healthy shell development.

Putting it together

Wash out the tank first, even if it is new, to remove dust, and in the case of a secondhand unit, use a special disinfectant such as Vetark's Ark-Klens, rinsing it out afterwards. An all-glass tank should be stood on a sheet of polystyrene, to absorb any unevenness in the surface on which it is resting.

A solid piece of furniture will be required to support the weight of the tank when it is full of water, if it is not on a stand. Avoid a position in direct sunlight, partly because the glass will soon start to become covered in greenish algal growth. The turtles could also become too hot if the sun is shining directly into their quarters. You can also fix a decorative backdrop scene behind the tank, to hide the wall covering here, and make it look more attractive.

As far as the interior is concerned, if you decide to use gravel, rinse this thoroughly under a running tap in a colander. Otherwise, even if it is sold as pre-washed, it will not be completely clean, and this will result in scum being evident on the surface of the water in due course. Natural rather than coloured gravel is probably the best choice.

There is usually little point trying to grow aquatic plants in the gravel, particularly for larger turtles, as these are likely to be uprooted and probably eaten too, but floating plants such as duckweed (*Lemna* species) can be added once the tank is complete. They provide some cover as well.

Tip the water in carefully, using a clean watering can for this purpose. Adding a water conditioner to the water will help to make the conditions more suitable for the turtles. Typically, a depth of 22.5cm (9in) will be adequate for larger musk turtles. You can then fix the heaterstat in place, angled into a roughly vertical position, but kept below the surface of the water. Fit the power filter too, at one end, and then arrange the rockwork. This must be fixed securely in place, away from the filter and heater. Only switch on the electrics at this point, once you have finished putting your hands in the water, and check that everything is working.

One or two?

Many people will instinctively think that it is better to start out with two turtles, but bear in mind that this more than doubles the amount of space required. It is also important to remember that in the wild, turtles are not social. True, they may be seen basking together in some localities, but this is a reflection of a suitable opportunity, rather than the establishment of a bond between individuals.

Choosing the turtles

Always remember that being a young turtle is hazardous in the wild, with a host of predators in and out of the water looking for what would prove to be a tasty snack. As a result, hatchlings tend to be alert and nervous too. From many points of view therefore, choosing the most active individual in a group is probably a good idea, certainly when compared with a youngster that sits on a rock, proving reluctant to move.

Do not worry that a young turtle appears quite wild - it will soon tame down once settled in its quarters at home with you, particularly if you follow a set routine when it comes to feeding. Before long, you should find that your pet comes over for food, and will ultimately feed from your hand if you want.

Healthy turtles are lively and swim readily, having no difficulty in maintaining their position in the water. Any individuals that appear not to be able to dive easily, but tend to bob around at the surface, are likely to have a serious health problem, usually pneumonia.

Looking at the turtle in the water can also make it easier to pick up any signs of injury, or indeed a fungal infection which can create the impression of a slight halo around an affected limb for example. Ensure there are no obvious signs of injury to the legs and tail, and the turtle's eyes are bright.

Handling

With everything prepared in advance, turtles can simply be placed directly in their

CONTINUES ON THE NEXT PAGE »

RIGHT Rockwork must be secure in the tank, so that it cannot topple over.

As young turtles grow, so they shed the outer layer of their shell, which flakes away, as can be seen here, with the newer dark shell beneath.

new quarters. It is worth remembering that turtles can bite if threatened, and they need to be handled carefully, not least because they are likely to be injured if dropped.

The safest way to lift smaller individuals is by placing your finger and thumb on each side of the shell. It is advisable to wear gloves when handling turtles or servicing their quarters, and always wash your hands immediately afterwards, using a germicidal soap.

Feeding

There is little point in feeding the turtles immediately at this stage, after the journey home. Leave your new pet to explore its surroundings and settle down for a day or two therefore.

When the time for feeding comes, use a separate lightweight acrylic tank for this purpose, so any uneaten food can be discarded afterwards, rather than being left to pollute the water in the main tank. It should be filled with water at the same temperature as in the main tank, before the turtles are transferred here.

There are a variety of pelleted turtle foods now available, with some being intended primarily for younger turtles. These should form their staple diet, but can be augmented with other items including greenstuff. They may snack on the duckweed growing in the tank too.

Provide as much food as the turtles will eat in about five minutes or so. Avoid using aquatic live foods such as live tubifex, because these - or the water in which they are sold - can introduce disease to the turtles' quarters. Tetra's Fresh Delica Bloodworm is ideal as a treat though, being supplied in nutrient-rich vitamin and mineral jelly. You can simply give a sachet of this food to your turtles. Avoid raw meat – this is potentially hazardous from a health standpoint, being a potential source of *Salmonella* bacteria, and does not represent a balanced diet either.

LEFT Young turtles, as reflected by this giant musk, can be shy at first, and if directly threatened, they may bite as a last resort. They have no teeth, but can still give a painful nip.

Care

Good hygiene is very important. You need to have a bucket and disposable or plastic gloves to use when cleaning the turtles' quarters, and wear gloves when handling them too. Always turn off the power before servicing the tank.

As a guide, you will need to carry out a partial water change every week, although this depends partly on the size of the turtles. A gravel cleaner, doubling as a siphon, can be used to remove stale water, but never suck water through here. Fill it with water from a watering can, which is useful to have to top up the tank as necessary. All dirty water should then be tipped away down an outside drain.

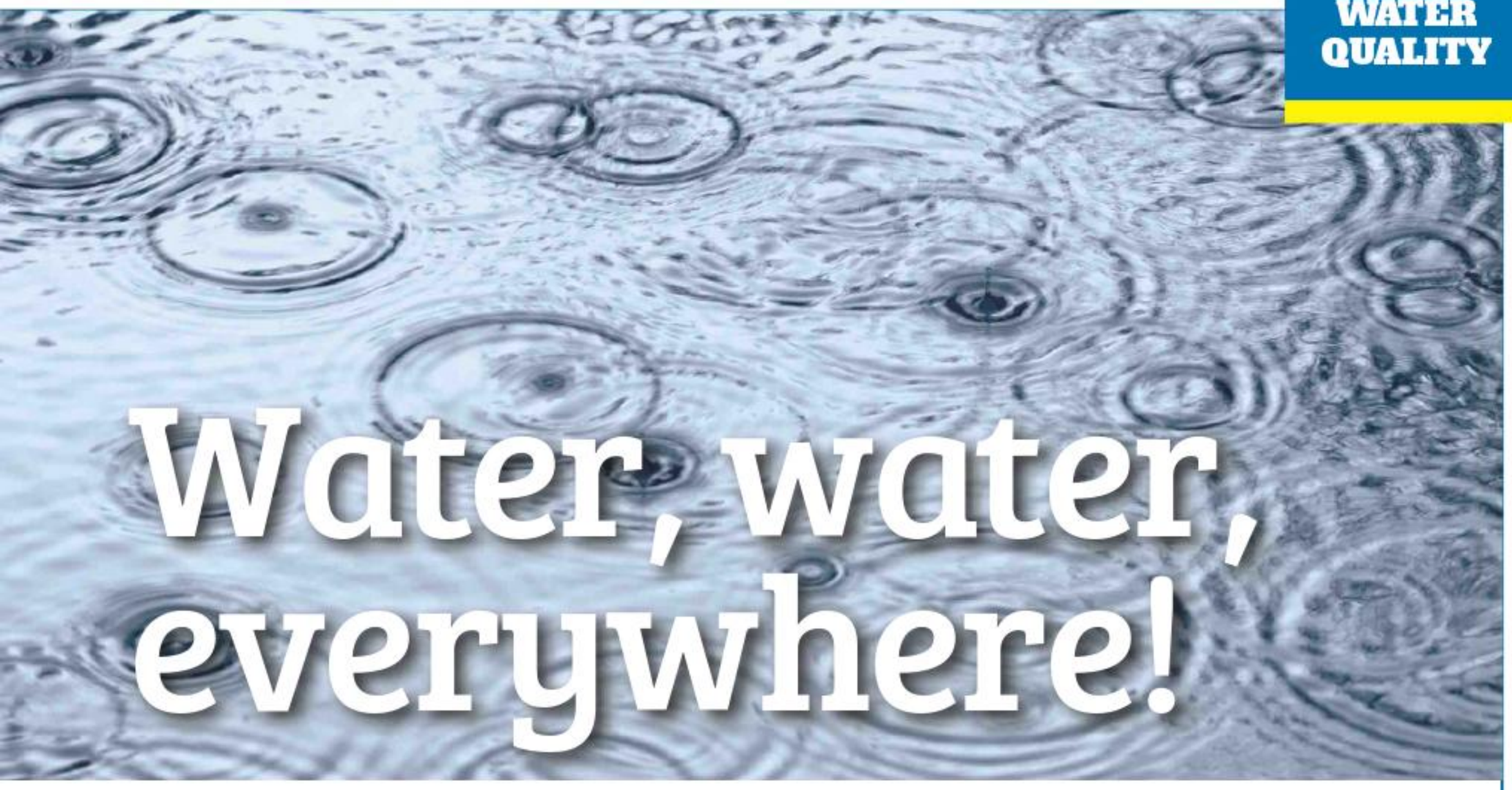
Sexing

Young turtles cannot be sexed visually, but as they grow, differences in size may become apparent, depending on the species. Male turtles generally have longer tails, and the genital opening is set further back towards the tip of the tail, compared with the female. The underside of the shell, called the plastron, may also be more concave in appearance in mature males. Courtship itself can be quite aggressive, with a male turtle usually snapping at the female's head and legs.

At present, the breeding of turtles in domestic surroundings is very small-scale, although there are no particular difficulties in persuading them to nest successfully. There are even specialist incubators available for hatching their eggs.

Breeding results can therefore be obtained, but remember that it will take a number of years before the young turtles become mature. The age of sexual maturity is based on size, rather than age, but musk turtles should be fully mature by about five years of age. Even so, it is worth remembering that if you start out with hatchlings, there is no way of distinguishing the sexes, so should you buy two individuals, the odds are against obtaining a true pair. If you do, then you will need to watch that the male does not persistently persecute his intended partner, leading to a loss of condition. Adding more retreats, and dividing up the their quarters with rockwork placed securely in place can help, but you may find yourself having to invest in a separate tank.

It is therefore important to decide whether you just want a turtle as a pet therefore, rather than for breeding purposes. Even if you think that ultimately, you may want to breed turtles, it could still be better to start out with just a single youngster, and wait for that individual to mature, so you can then be certain of obtaining a partner of the correct gender in due course. After all, there is no great hurry, as they may live for 30 years or more!



Water, water, everywhere!

As far as most people are concerned, water is a commodity that comes out of the tap. It's colourless, odourless and can be used for a multitude of purposes from drinking to washing the car, writes **Dick Mills**. None of its mysterious properties are usually of interest to us and if we're honest, we take it very much for granted. The only times we get vociferous about water are when there is a shortage in the summer or if a surplus is falling from the sky – also usually during summer too!

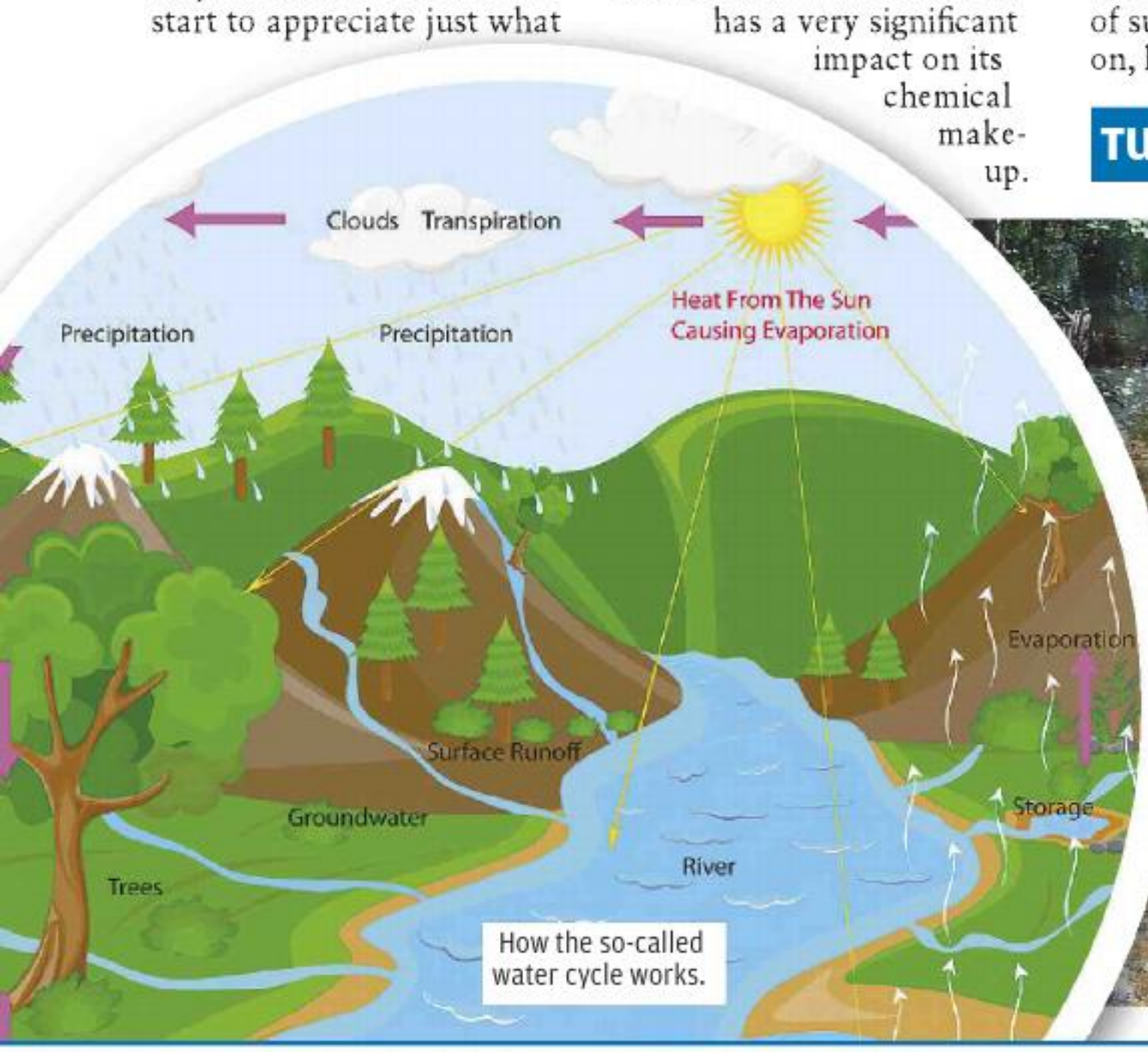
Fish are surrounded by water and yet, fresh water species, unlike their marine relatives, actually drink very little of it. Even so, water is critical to their well-being – they swim in it, and will live, breed and die in it – so it is essential that its quality is maintained, if they are to thrive. Before we start to appreciate just what water means to the fish, it is important to understand that water is not the same the world over, even though it has a worldwide common origin in the sea. Thanks to evaporation and condensation, water arrives on land without us having to go and get it. But how it arrives and where it arrives has a very significant impact on its chemical make-up.

Changing constituents

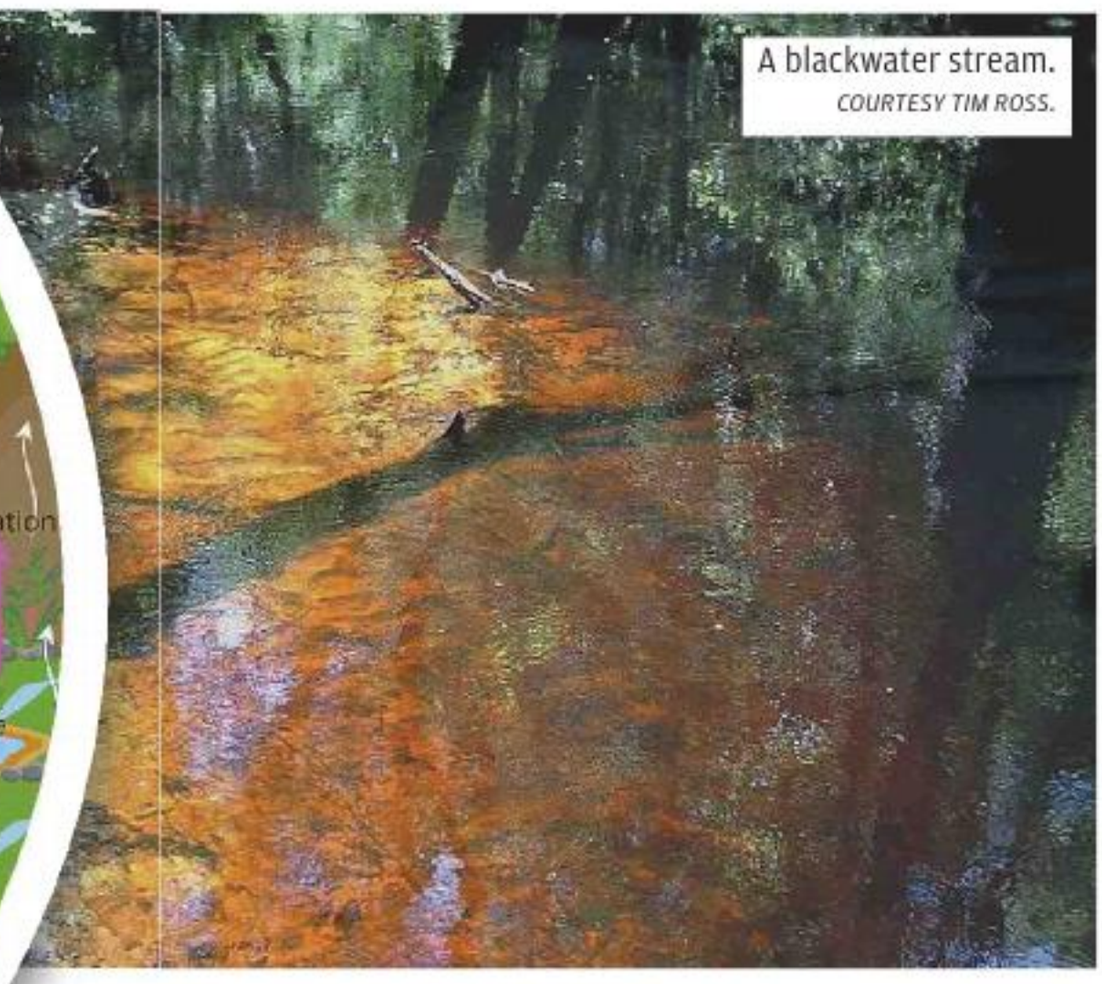
Falling through the atmosphere is the first opportunity that water gets to become affected by contamination; this is particularly so if it falls over heavy industrialised areas where there are atmosphere-polluting outpourings. Then it depends, too, on what type of surface it eventually lands on, having fallen to earth.

Hard, impervious surfaces will not affect it, with the water running off quickly. In more absorbent areas, the water will soak away, and again picks up 'contaminants' on the way. In forested areas for example, water here will be affected by any decaying vegetation in its path. In an extreme cases, this can lead to so-called 'black water', which is heavily laden with tannin

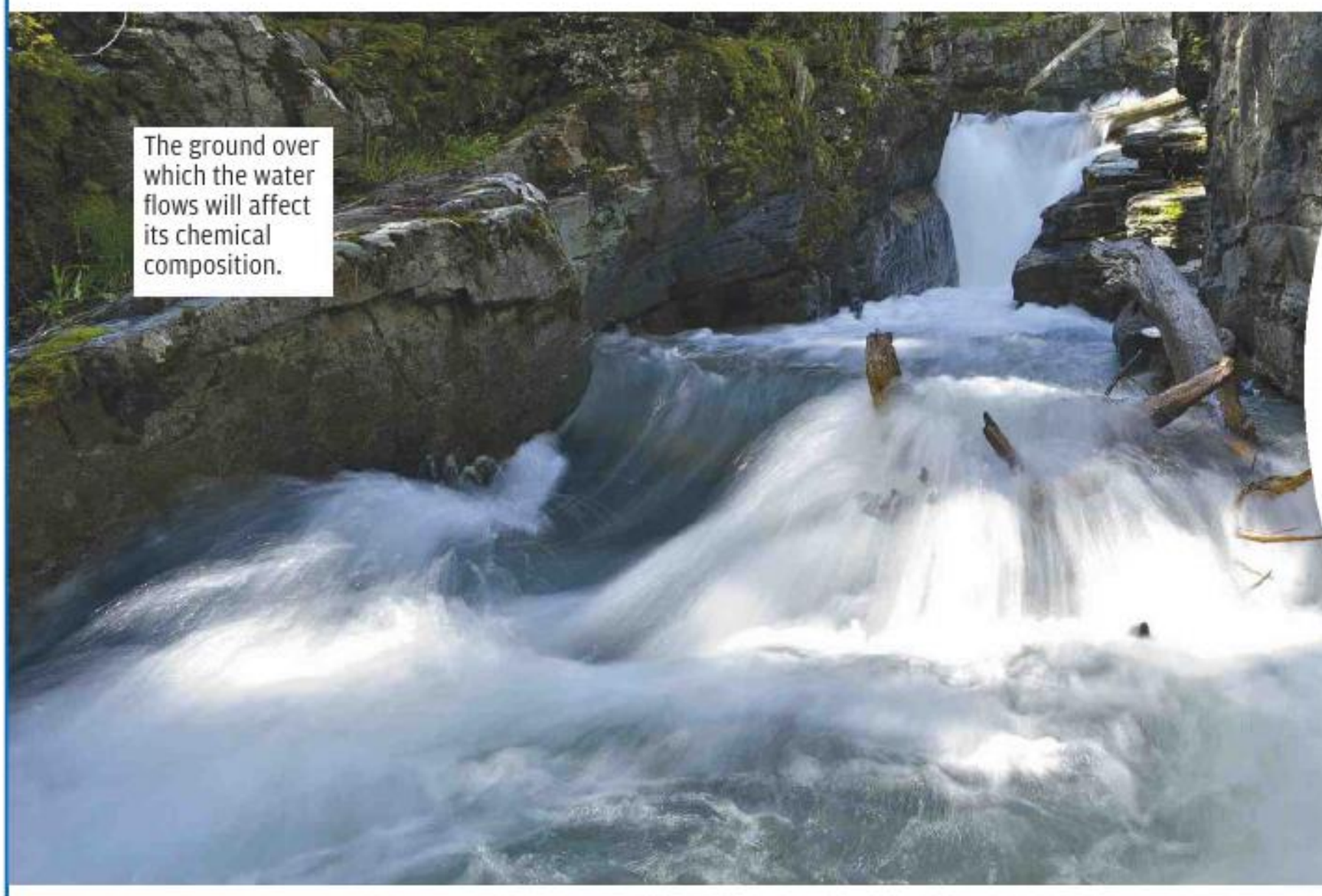
TURN OVER FOR TOP TIPS ON WATER CARE »



How the so-called water cycle works.



A blackwater stream. COURTESY TIM ROSS.



The ground over which the water flows will affect its chemical composition.

from decaying vegetation.

Water is also affected by movement (or lack of it). Fast-flowing mountain streams are well-oxygenated, and water here is not likely to pick up too many pollutants as it crashes quickly down hillsides. On the other hand, shallow stationary jungle pools containing lots of rotting leaves are likely to be oxygen-depleted.

OK, so you can probably name quite a few species of fish which come from these different types of environment – and you expect them to live happily in whatever comes out of your tap? There is even more to know about water when it comes to ensuring the well-being of your fish.

Hard or soft?

Most people will be familiar with the concept of 'hard' or 'soft' water, and usually are most aware of the difference when they spend a holiday in a different part of the country, away from where they normally live. Soap lathers more easily in soft water and one tea manufacturer actually produces a tea specifically for hard water areas, where kettles, washing machines and other similar equipment can "fur up" easily with dissolved limescale that was present in the water.

Fish can also be affected by changes in water hardness. In nature, they may occur in the soft waters of mountain streams or in the far harder waters of the Great Africa's Rift Valley lakes, where the water has run down through limestone, becoming hard as a result. It is therefore important to be aware of the natural environment in which your fish occur, in terms of hard/soft water, so you can plan accordingly, before you get them.

It is not just a question of reading up where the fish come from, but rather what type of water they have become acclimatised to, when you buy them. The subtle difference today is that the vast majority of fish offered for sale are captive-bred and not caught from the wild, so always discover what they are actually living in, rather than what they theoretically need. As domestication has proceeded, so many species have proved to be more adaptable than their wild cousins. For breeding purposes though, you may need to revert more towards the water conditions that the ancestors of your fish would have experienced in the wild.

pH values

Another issue that needs to be considered is whether the water is acid or alkaline. This aspect of water quality is often regarded as too technical for the average hobbyist, but a little appreciation of what is involved is certainly not hard to grasp!

Just as fish will not take too kindly to being exposed to wide differences in hardness, so they can also become stressed if a sudden or too great a change is made on the acidity/alkalinity front.

The unit by which this

DID YOU KNOW?

As a general rule, most egglayers such as tetras, barbs and rasboras like softer water, whilst livebearers and cichlids from both central America and the African lakes prefer hard water surroundings.

Zebra danio – a fish which lives in soft water surroundings in the wild.

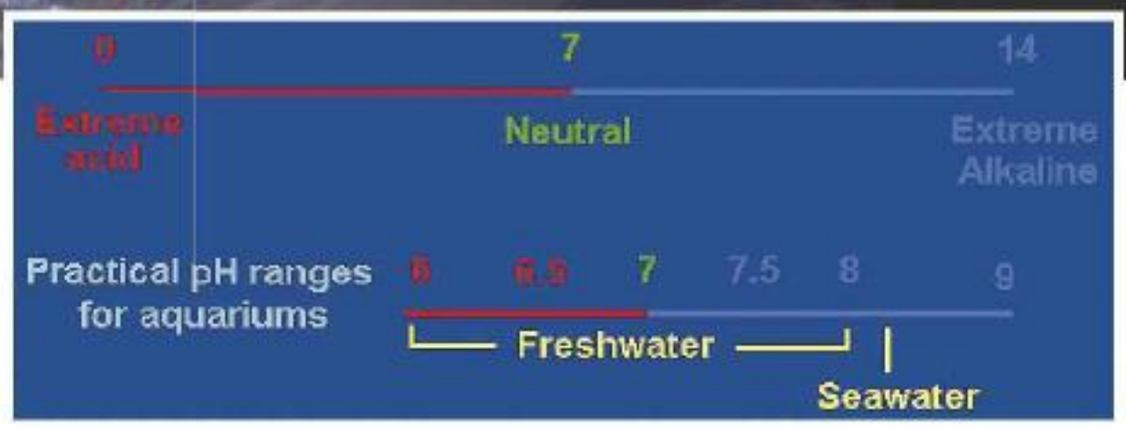
Platies and most livebearers favour hard water.

Water will erode limestone readily, creating underground caves and the dissolved calcium and magnesium salts affect its chemical composition, causing the water to become harder.

Aside from test kits, it is now possible to take direct readings to determine water quality, using a range of electronic meters.

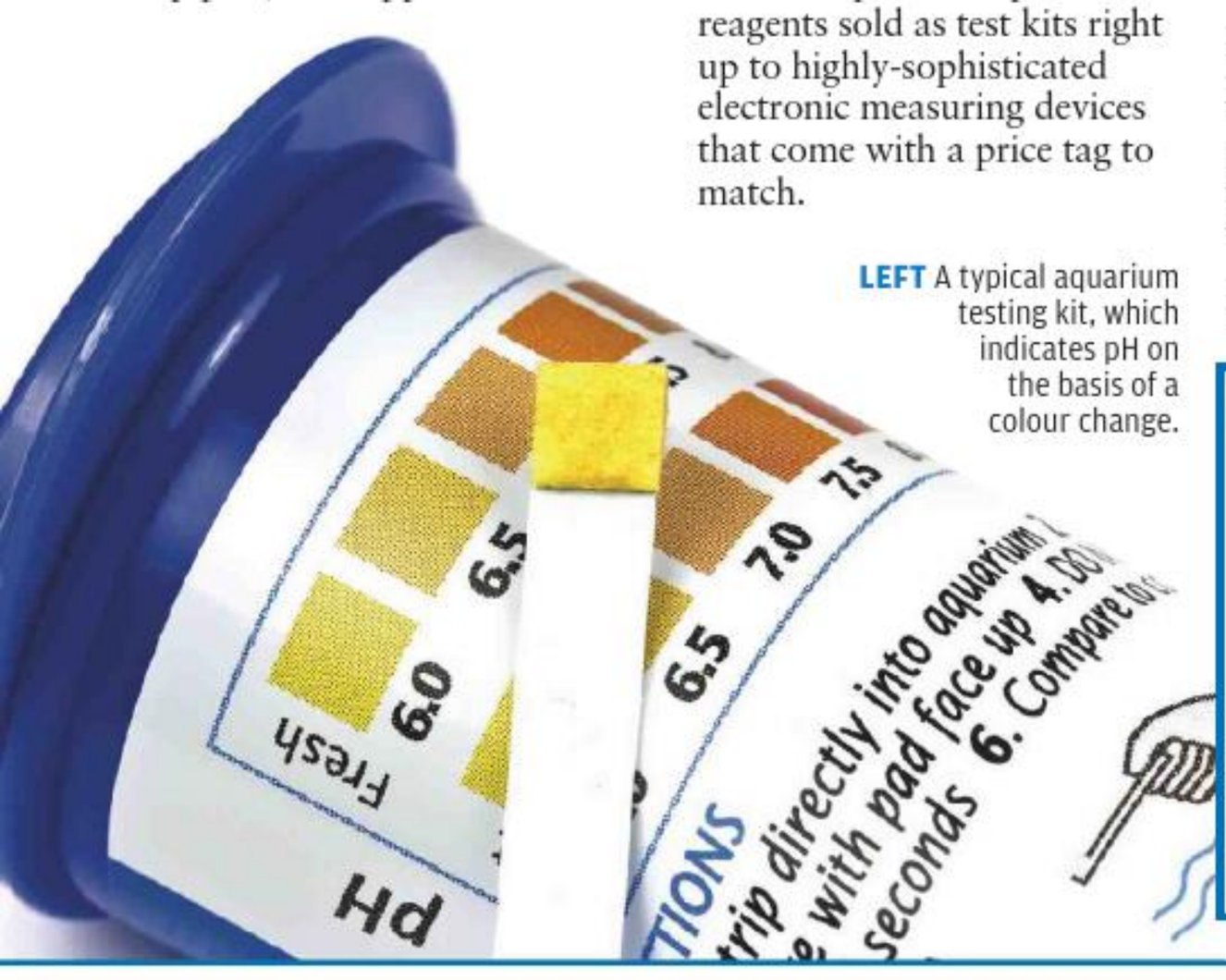
particular water quality is measured forms part of the pH scale. The complete pH scale ranges from 0 (most acid) to 14 (most alkaline). However, the range that most concerns fish (and their owners) occupies a relatively narrow band of values from, say, 6.00 to 8.00 which, as you can see, straddles the halfway value of 7. This is neither acid nor alkaline, and therefore described as neutral.

Domestic tap water generally has a pH value of around 7.2 or more (because more acidic water used to play havoc with lead supply pipes!) so it appears to be quite suitable for the needs of most fish. Naturally, there will always be the exceptions, although again, it may not be until you take up breeding fish that extra attention to the pH reading of the water is really necessary.



LEFT The pH scale. *COURTESY OF THE AUTHOR.*

Measuring these two parameters of water quality is not difficult as there are many accurate testing systems on the market. These range from inexpensive liquid/tablet reagents sold as test kits right up to highly-sophisticated electronic measuring devices that come with a price tag to match.



LEFT A typical aquarium testing kit, which indicates pH on the basis of a colour change.

Getting it right!

The problem comes when, having found out the chemistry of your water, you want to keep it stable or, alternatively, to change it. Again, there are many additives for adjusting acidity/alkalinity and devices to remove or increase hardness. Whatever route you decide to take, you must remember to make all changes on a small scale, and, preferably, over a fairly lengthy period in order not to stress the fish. It's a pretty sure bet that most fishkeepers top up their tanks every time they see that gap appearing above the water level but below the aquarium trim.

This is great for restoring the 'full picture', but not if you fail to couple this with a partial water change. As water evaporates, only pure water is lost – any salts, minerals and nitrates for example dissolved in the water are still there, and topping up only adds to the total amount of dissolved solids, effectively increasing their concentration.

Other, perhaps unexpected signs of water quality problems may crop up. Algal overgrowth can arise because of relatively high levels of nitrates and phosphates in the water, assuming there is adequate planting and the correct duration of lighting. The levels of these chemicals will need to be controlled by water changes and by the use of the appropriate removal agents, used in conjunction with a filter.

In summary

Regular partial water changes are probably the most important, albeit most basic, maintenance task that really contributes to success in the aquarium, whether it be actual water quality or the overall condition of the fish.

Finally, don't become a slave to softness/hardness or pH numbers. Watch your fish instead and how they are behaving. I always think of the story of a visitor to a fish event, who told an advisory service there that he had a problem with pH. After discovering that all his fish were happy and healthy, the diagnosis was "Yes, you've got a problem with pH, but in fact, your fish haven't!"

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ABOVE An *Oodinium* sufferer. *PHOTO COURTESY TZE SIN, TAN.*

BATTLING AGAINST DINOSPORES

Q I've brought some gouramis recently and they don't seem especially happy in their quarantine tank, repeatedly rubbing themselves against the rocks here. Any ideas?

A They are likely to be suffering from the relatively common parasitic ailment known as velvet disease. This is caused by a tiny microscopic creature called *Oodinium*, which is part animal, part plant. It has the green pigment chlorophyll in its body so that it can make its own food by photosynthesis, like plants, but also hunts microbes, and multiplies on the bodies of fish.

When infected by *Oodinium*, fish scrape themselves on rocks and other objects in the aquarium to ease the irritation caused by these parasites boring into their skin. They become rather hyperactive in bursts, while keeping their fins clamped down against their bodies at other times.

If you look closely, you may see that the affected fish have a yellowish-grey hue on their bodies. There can also be obvious yellow speckling, especially on the fins if these are clear in colour. This is why an *Oodinium* infection may alternatively be described as 'gold dust disease'.

Gouramis and other fish are vulnerable as the parasite spreads so effectively within an aquarium.

Q How do I deal with this problem?

A Use a specialist treatment to kill these parasites, which is available from most aquatic stores. This can usually be added to the tank containing the fish, although you will need to work out the volume accurately, to ensure that you are giving the correct dose. *(See our Living in Harmony article in this issue, to explain how you can do this very easily – ED).*

The major problem with treating *Oodinium*, as with other aquatic illnesses, is that the infection spreads through the water. If you have several tanks of fish therefore, never use a net dipped in this aquarium to catch fish housed elsewhere, because the droplets of water on the net will be sufficient to transfer these parasites from one tank to another. Keep a separate net for each tank, to prevent any risk of cross-infection.

"The major problem with treating Oodinium is that the infection spreads through the water"

It is better to treat the most severely affected fish in an aquarium on their own, as a way of reducing the risk of the others developing a serious infection. This is because after attaching to the fish for up to a week, the *Oodinium* parasite will swell up and rupture, with each one releasing over 200 spores.

In the confines of an aquarium, these so-called dinospores will have little difficulty in finding a host that they can infect, and so the cycle continues, with the infection soon proving to be overwhelming. They anchor themselves in place on the fish's body by means of a root-like structure, and develop a protective covering, forming a cyst. This is what you see that appears yellow.

A few days later, once it matures, so the cyst detaches from the fish's body, and falls to the floor of the aquarium. It will then give rise to the next generation of dinospores, allowing the numbers of these parasites to build up to overwhelming numbers in a short space of time. Fish weakened by the first wave of attack by these parasites are very likely to succumb when they are attacked again almost immediately afterwards. It is vital to begin treatment as soon as you seen any signs of infection, before the gills are severely damaged, preventing the fish from breathing normally.

Q Is there anything else that I can do to help to eliminate these parasites?

A Raising the water temperature slightly is likely to be beneficial,

because this increases the speed of the parasite's life cycle. As a result, the dinospores must find a host more quickly, if they are not to die within just a day or so. Otherwise, they may survive for 5 days or even longer. Increasing the temperature can also have the effect of boosting the fish's immune system as well, helping it to fight the infection more effectively.

Q What caused the problem? The fish looked healthy at the time of purchase.

A The trigger could have been the stress of the move. It is possible that at least one of the fish was carrying the infection, and this is why it flared up and spread rapidly. Alternatively, it could have been introduced via the water in which the fish travelled home. There is also some evidence to suggest that infections have resulted from the parasite surviving in a dormant but viable state in frozen live food such as bloodworm, so it might possibly have come from the food that you have been offering to your fish, but this is would be highly unusual.

Q The breathing of one of the gouramis also appears to be more laboured than usual. Is this another sign of this illness, or an unrelated problem?

A It is almost certainly linked, and you have been lucky not to have lost any fish as a result. If *Oodinium* attacks the gills, fish can die suddenly since their ability to extract oxygen from the water will be severely reduced.

Top tips

Better aquarium water quality

Poor water quality can also cause the fish to have difficulty in breathing, and if the environmental conditions are bad, so this will leave them more vulnerable to illness. Regular partial water changes are therefore recommended, to ensure the water in their aquarium remains healthy for them. Remove up to 20% of the aquarium water every three weeks or so, replacing it with fresh water which has been treated with a water conditioner.

Are other fish susceptible?

Yes. It is not just gouramis that may be affected by *Oodinium*. Other tropical freshwater fish such as killifish, and even goldfish are susceptible, while similar parasites affect marine fish. This is why it is important to look carefully at all the fish in a tank carefully, before deciding to buy any. Otherwise, although the fish that you choose may appear healthy, they might already have been infected by others in the aquarium, with the parasite also present in the water.

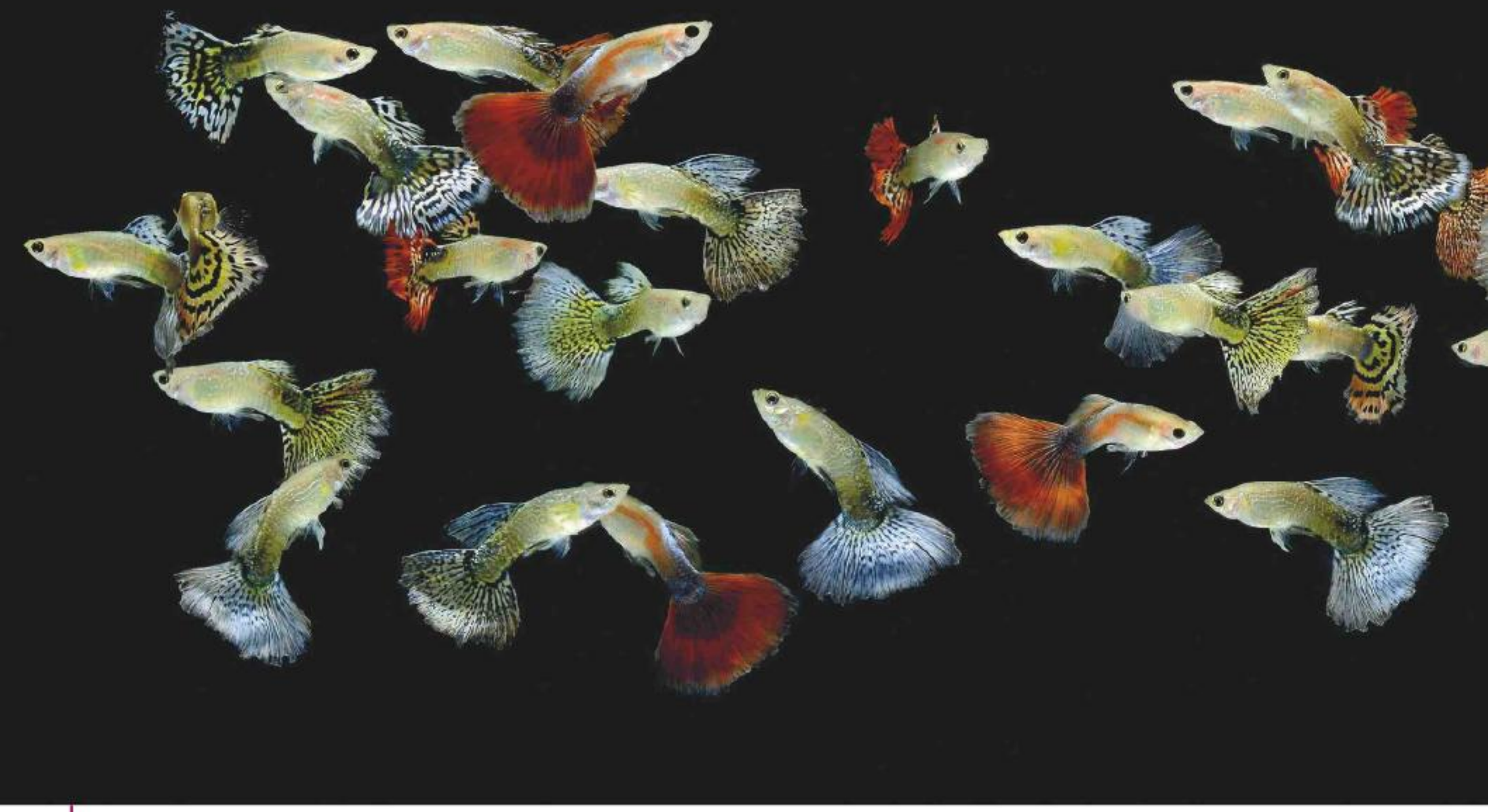
What is the best way to disinfect an aquarium?

Use one of the proprietary disinfectants now available for this purpose, in strict accordance with the stated instructions. Nets should be treated each time after use, if you do not have a separate net for each tank. They represent the simplest way of spreading infection from one group of fish to another. Do not use general disinfectants on nets and other aquarium equipment though, as any residues are likely to be toxic to the fish. An effective means of curbing these parasites in the tank would be to cover it completely, disconnecting the lighting system. This blackout prevents the parasites from photosynthesising, and so severely restricts their food supply, but this can equally have severe effects on any aquarium plants present. This method is really only suitable for tanks containing plastic plants.


A harlequin rasbora afflicted by white spot. PHOTO COURTESY PHOTOMAX AT THE GOLDFISH BOWL

Is velvet disease similar to white spot?

Yes, it is, but the spots in the case of *Oodinium* infections are yellowish, rather than white, and also smaller in size. If you are in doubt about recognising the spots, try shining a torch at the affected area, as this can highlight them, making the problem easier to distinguish in the critical early stages.



How fish keeping changed our lives

It was a fascination with fish that helped to spark true romance for Susie Kearley, as she reveals in this story.

SUSIE KEARLEY
Aquarium writer

In 1998, when I first met Vic, the man who would later became my husband, he was already a dedicated fish keeper, with a tank full of colourful guppies and catfish. In fact, he was so keen about sharing his passion that for my birthday that year, he bought me an aquarium.

Starting out

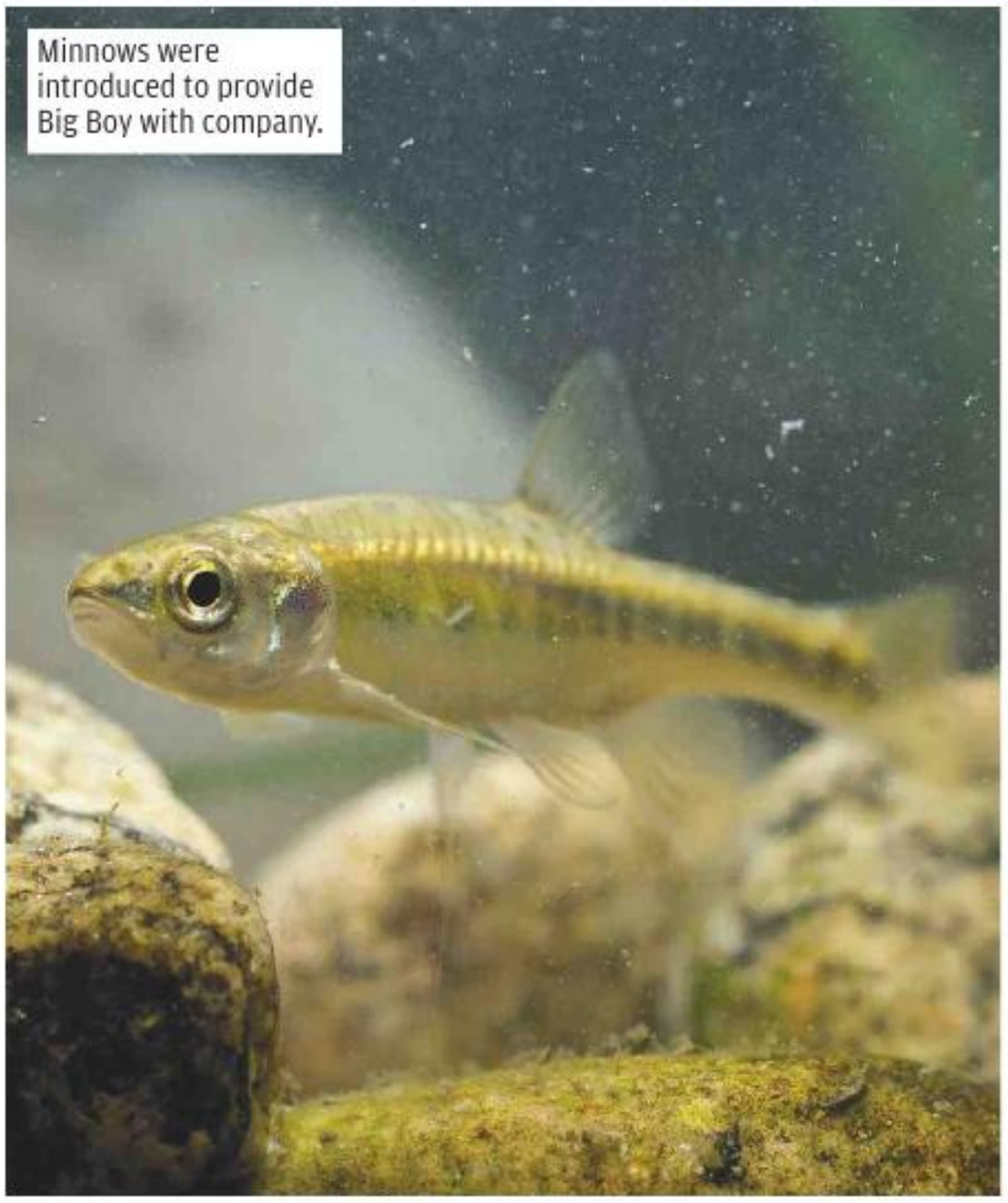
It was hexagonal in style, and came complete with two black mmoors and two fancy white goldfish. They were all about 2.5cm (1in) in size, making them real tiddlers in goldfish terms. The decor that Vic had chosen was in the form of a skull - this was a goth-styled tank to match my taste in clothes and music!

It was my first taste of serious fish keeping, with my only previous experience having been the time when I won a goldfish at the fair as a young child. Mum bought one of those round glass goldfish bowls which were widely-sold back then, and the poor thing swam in circles for a couple of years before departing this world. Looking back, I can't help thinking that loneliness and boredom may have played a part in its premature demise.

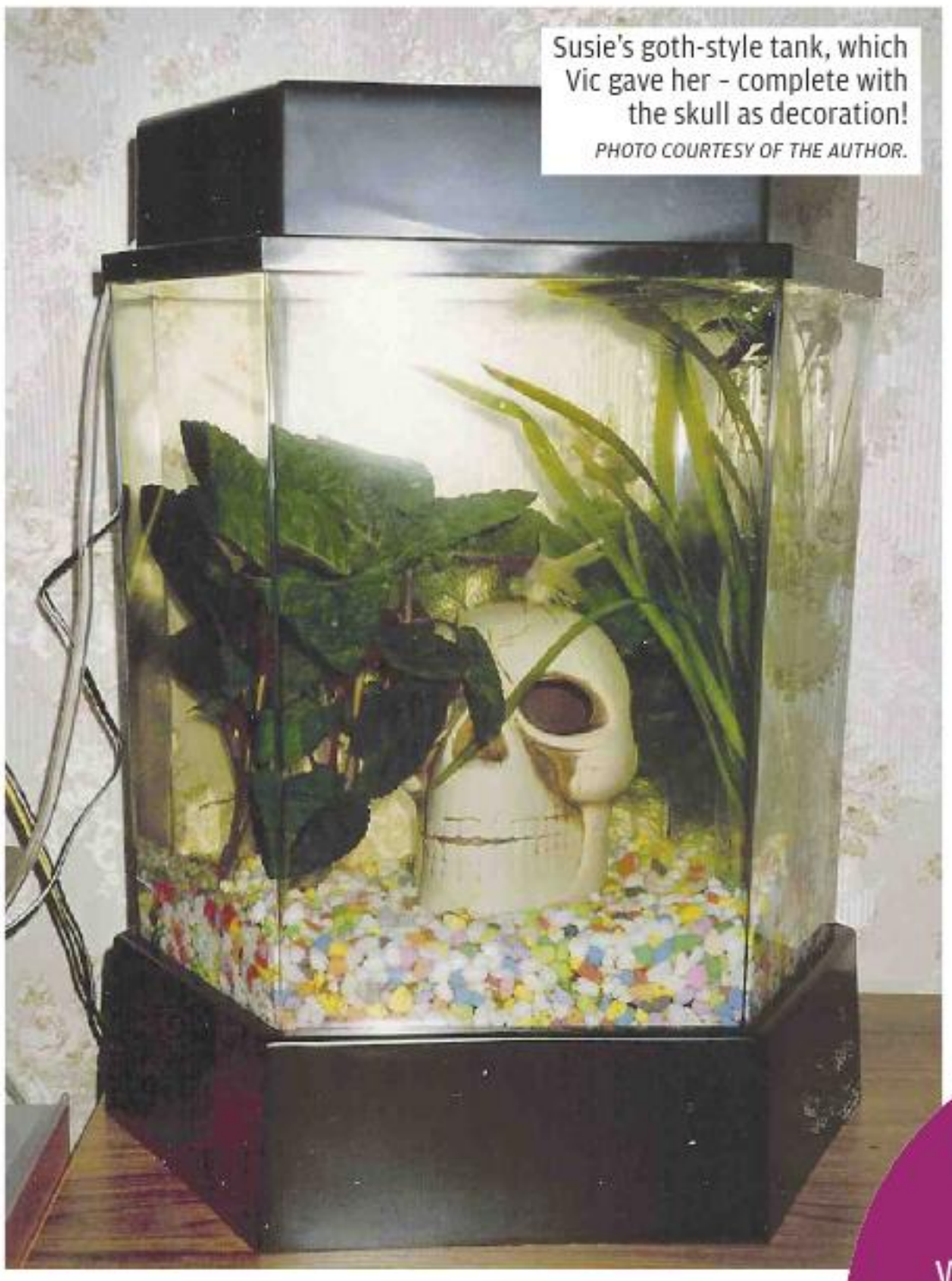
So anyway, by the time Vic bought me a gothic fish tank, complete with suitable coloured fish, I was then in my mid-20s. The tank had a filter and gravel, and the fish stood a much greater chance of a happy life because I was older and more knowledgeable.

LEFT Moors are very distinctive goldfish.

Guppies were one of Vic's favourite fish.



Minnows were introduced to provide Big Boy with company.



Susie's goth-style tank, which Vic gave her – complete with the skull as decoration!
PHOTO COURTESY OF THE AUTHOR.

How things progressed

The two black moors grew at different speeds, so that one became known as Big Boy, while the other was Little Boy. Someone suggested that Big Boy might be a girl, but I never tried to sex the fish. Little Boy failed to thrive though, and often suffered from swim bladder problems. I treated this condition with aquatic medicines and tonic salt, although with limited degrees of success.

Big Boy grew increasingly bigger, so we moved all four fish into larger tanks twice. Eventually Little Boy died - he'd never really been healthy, despite our greatest efforts to assist him. One of the fancy white goldfish died too.

Unappreciated companions

I was left with Big Boy, now a large black moor, and a single fancy goldfish, so we decided to add six minnows to the tank. Some time later, the last of the fancy goldfish died, so we bought a weather loach to provide a companion for Big Boy. Continuing to grow, he had reached about 30cm (12in) in length by this stage.

The weather loach, however, far from being friendly and good-natured, was very unsociable and hid in the gravel. The minnows started disappearing at night and soon there were none left. We eventually concluded that the weather loach had eaten them. Big Boy wasn't fast enough to catch them even if he wanted to!

A transformation

With only the unsociable weather loach for company, Big Boy looked depressed and would spend hours sitting on the bottom of the tank. It wasn't a swim bladder problem. He could swim if he wanted to, but he chose not to do so. He also started to develop fungal infections and we went to great lengths to treat him with medicines and tonic salt, with erratic and generally disappointing results.

As he was quite old for a black moor, we weren't sure how he would take to new company, so we did not rush to buy him new friends – we later wished we had!

The problems and the fungal treatments went on

CONTINUES ON THE NEXT PAGE »

DID YOU KNOW?

Weather loaches are so-called because they become more active in response to changes in atmospheric pressure, and so were first kept centuries ago to forecast the weather.

Goldfish and other cold water fish provide an introduction to fish keeping for Vic.

Goldfish interacting together in a pond.

Popular Fish Keeping Vic's top tips

1 Use medical syringes to start your water siphoning through an air hosepipe. This technique is useful when you're siphoning water out of the tank, and also when you're adding fresh water. It mixes the new water in slowly so that it doesn't distress the fish.

2 Use the dirty water from your tank to feed your garden plants because it's full of nutritious nitrates, from the breakdown of waste in the tank, which helps your plants to grow.

3 Wash filter sponges in water that you've removed from the tank. This serves to keep the healthy bacteria alive – these bacteria are essential to the health of the fish. If you wash your sponges in tap water, the chlorine will kill some of the bacteria, reducing the efficiency of the filter as a result.

4 Keep a bristle-nosed cat fish in your tropical tank as they feed on algae and keep the glass clean.

ABOVE It is not just algae on the glass that bristle-nosed catfish will consume. They will also control algae growth on rockwork and other tank décor.

for months, perhaps for over a year - I don't remember exactly. Eventually, we decided to see if giving him more company helped. We caught a goldfish from our pond and put it into his quarters. Big Boy's transformation was miraculous.

The fungal infections vanished and he was swimming around very happily with his new companion. We wished we'd done it earlier. It seemed that he really had been depressed because his pals had died and the weather loach was clearly not his ideal companion!

The sad end

It was a year or so later when Big Boy died at the age of around 10 years. It was such a sad day. He'd become a part of the family and was a major attraction when anyone came to visit. He was so big that we tried to put him in a tissue box coffin to bury him, but we couldn't fit him in properly. When we simply buried him in the garden, a fox came by a week later, dug him up and ate him, which was very upsetting. We found the evidence in the morning.

We put the weather loach and the other goldfish in the pond outdoors. True to form, the weather loach hides on the bottom mostly. He lives in the pond with about 30 goldfish, and so there's plenty of company if he has an urge to be sociable. Finally, we moved Vic's tropical fish into Big Boy's large tank where they are still thriving today.

One of the most valuable lessons I've learnt from the whole experience is that one of the single most important factors for a healthy goldfish, is company – these are sociable fish. As Big Boy showed, a happy fish under these circumstances can fight off infections naturally - and yes, I think fish really can get depressed.

Vic's fish keeping

Vic's interest in fish keeping goes back to his childhood. He was about 9 or 10 years old when Father Christmas bought him an aquarium. It was a cold water tank and he kept a few fancy fish in it, developing his interest as time passed.

He learnt a lot about fish keeping during those years. Not least, the amount of looking after that they required, in terms of cleaning out, changing filters, checking water temperatures and other

Clown loaches are included in Vic's present aquarium, living happily alongside his breeding mollies.

BELOW Male mollies are one of a number of aquarium fish that will actively prefer to pair with individuals that have bred before.

similar tasks. Regular care and attention to maintaining water quality was critical to their survival - a lesson that he learnt some years later when his maintenance routine slackened.

Vic says: "As a child, the biggest challenges I faced were with my cold water fish. They were constantly suffering from fungal infections. Mum and I tried treating them with salt water but we didn't have the chemical treatments that are available today, and my efforts didn't seem to have much effect. Once they got ill, they usually died.

"One of the biggest mistakes I made in those early days was using a medical treatment that killed two of my fish. I read the instructions in full after that, and realised that the treatment was unsuitable for the particular species of fish that I needed to treat.

"I hadn't recognised the scientific family name used in the instructions. It was really upsetting at the time, but I learnt a lot from those early mistakes. The moral of that story is always to read the instructions in full, and if you don't understand them or have any doubts, double check, look it up, or ask an expert!

A range of experience

"I enjoyed fish keeping though, and liked the different varieties of fish, so a few years on, I got a bigger tank on a metal stand. At the age of 13, I moved it into my bedroom.

"I had an aggressive catfish which kept attacking my other fish, so I moved him into solitary confinement. That second tank was in my bedroom too and I remember the catfish went beserk at night and used to keep me awake. Like a number of his kind, he seemed relatively quiet and peaceful during the day, but being a nocturnal fish, he came alive at night.

"It was some years later when I then got my first tropical tank. It came from a lady over the road. She discovered that I'd developed an interest in fish keeping and kindly gave me her big bow-fronted tank. It was a lovely aquarium and I kept Guppies, platies and swordtails in it for years.

"Things only started to go wrong when I lost interest at the age of about 17. I didn't clean the tanks frequently enough, and some of the fish

Reverse osmosis units may fit above or below the sink. They're not just produced for use with aquarium set-ups!

died. I gave up fish-keeping then, until my mid-30s when I bought a house, and decided it would be nice to have a tropical tank as a focal point on the hearth, because I had no fire in the fireplace. That was 20 years ago and I've been keeping tropical fish ever since."

Today's aquarium

When Susie first met Vic, he had been breeding Guppies for years but eventually, they died out due to inbreeding within a small gene pool. Vic's tropical tank now contains dozens of mollies that breed like rabbits, a couple of clown loaches, and a bristle-nosed catfish. He'd like the tank to have more variety, but it's so full of mollies and he doesn't feel it would be healthy to add more fish to it. He has given some away, but they still keep breeding!

Vic does have some frustrations: "I've never been able to get plants to grow properly – I've tried feeding them and buying special lights designed to encourage them to grow, but to no avail."

Fish keeping leads to a worrying discovery

A few years ago, Vic was also struggling with the water quality in his fish tank. His test kits were showing high nitrate levels so he was trying to get the nitrate levels down and persistently failing. That's when he decided to test the water source - the kitchen tap. The results were an eye opener. The nitrate level in the tap water was as high as that in the tank!

With nitrate levels of the water supply right up at the legal maximum, we decided to invest in a water purification system for our water – not just for the fish, but also for our own health. High levels of nitrates are not considered beneficial for humans either, as they've been linked with various cancers.

Vic says: "You can buy a filtration system to remove nitrates, but it's quite fiddly. Our under-sink reverse osmosis system (R.O.) does improve the water quality, but even that doesn't eliminate nitrates altogether. It's just a question of doing what we can, to minimise the presence of undesirable contaminants in the water. Today, a lot of aquatic shops sell reverse osmosis water for this reason."

A lasting difficulty

One of the things that we still haven't quite worked out is the best approach to optimising the look of the background scene for the tank. After trying to put it inside, we found it floating in the tank. So we then attempted to stick it to the outside, but couldn't see it properly. Finally, we ended up buying a special oil for fixing it to the back of the tank. But now we have black air bubbles as large as the bits of the paper that have adhered to the tank. It didn't start off that badly – these areas have grown larger over time!

Smell and taste in fish

These senses are not just associated with finding food. Living in what is generally a dangerous environment, fish will rely on all their fine-tuned senses for survival. **Dr Julia Mueller-Paul** reveals more.

The aquatic environment inhabited by fish is often dark and/or cloudy, which makes vision difficult. Chemical substances, however, dissolve and spread very well through water. Furthermore, chemicals can be detected in two different ways – via both taste and smell.

Vital senses

It is therefore not surprising that most fish have very highly developed senses of smell (known as olfaction) and taste (described as gustation). These play a major part in their lives. Social interactions, feeding and finding shelter, courtship and reproduction, as well as avoiding predators are just some of the areas for which chemical information is essential to many fish.

In the case of animals that live on land, the difference between taste and smell is usually defined by the medium through which the chemical is transmitted. This means that smell is normally used to identify airborne chemicals, with taste being relied upon to detect chemicals dissolved in foods containing water.

Since all the chemicals that a fish will detect are in water, the question then arises as to the difference between smell and taste in these vertebrates, as well as the need for two distinct systems. The fact is that the border between these two senses can become blurred in the water. However, fish do possess separate olfactory and gustatory systems, and the easiest way to distinguish between taste and smell is through the organ that processes these chemical messages.

An all-round taste!

Another, more vague distinction is the function that the two systems have. The sense of taste tends to deal with simpler, more reflex-based behaviours such as those involved in feeding, whereas smell is concerned with more complex behaviours like courtship, learning, and locating the sources of specific smells.

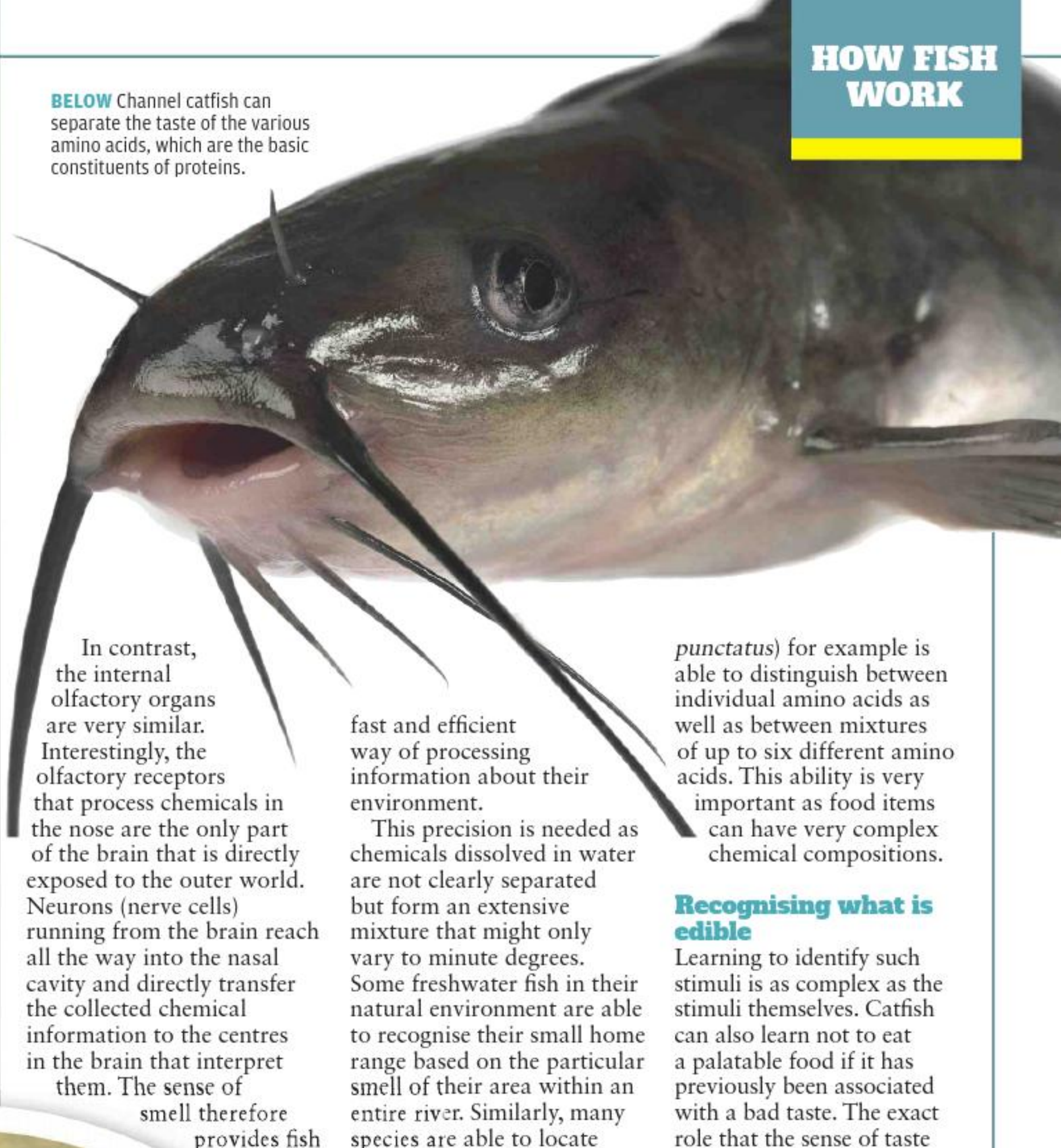
"...the sense of taste of some fish is up to 500 times as sensitive as that of humans!"

The sense of taste is based on chemicals which are collected by gustatory cells located in the fish's taste buds and then transferred to the brain via specific nerves. The taste buds of fish are not only found in their mouths though, but can be distributed over their entire body, including their fins.

This greatly enhances the surface area that can collect chemical information from the surrounding water, increasing the likelihood that even very small amounts of chemicals will be detected. In fact, the sense of taste of some fish is up to 500 times as sensitive as that of humans!

Differences in anatomy

The external structures associated with the nose vary greatly between species, in the case of fish. Some have only one nostril while others have two, and the location of the nostrils can be equally variable. They may be placed below the snout in some cases, while alternatively, they can be situated above the snout.



BELOW Channel catfish can separate the taste of the various amino acids, which are the basic constituents of proteins.

Aquarium fish can adapt easily, and recognise what are unnatural, artificial foods without difficulty, even if they have not encountered them before.

In contrast, the internal olfactory organs are very similar. Interestingly, the olfactory receptors that process chemicals in the nose are the only part of the brain that is directly exposed to the outer world. Neurons (nerve cells) running from the brain reach all the way into the nasal cavity and directly transfer the collected chemical information to the centres in the brain that interpret them. The sense of smell therefore provides fish with a very fast and efficient way of processing information about their environment.

This precision is needed as chemicals dissolved in water are not clearly separated but form an extensive mixture that might only vary to minute degrees. Some freshwater fish in their natural environment are able to recognise their small home range based on the particular smell of their area within an entire river. Similarly, many species are able to locate their prey with immense precision, even in turbulent, fast flowing waters.

Sophisticated taste

Most fish are adaptable in terms of their feeding habits, meaning that they accept a wide range of food and do not require one specific food item. As a result, their senses of smell and taste need to be adept at recognising certain features of a possible food item, so that it can be classed as edible or not. Some of these responses are innate and present from hatching/birth, while others are learnt on the basis of trial and error, or by observing other fish.

Amino acids have been found to be one group of chemical substance that are particularly important with regard to taste. The channel catfish (*Ictalurus punctatus*) for example is able to distinguish between individual amino acids as well as between mixtures of up to six different amino acids. This ability is very important as food items can have very complex chemical compositions.

Recognising what is edible

Learning to identify such stimuli is as complex as the stimuli themselves. Catfish can also learn not to eat a palatable food if it has previously been associated with a bad taste. The exact role that the sense of taste plays in feeding, compared with the sense of smell, is not fully understood.

It appears that both senses are involved in feeding behaviour. Feeding responses are affected, but a fish will not stop eating completely when one of these senses is impaired. It is possible that smell plays a greater role in the detection of and learning about food, while taste is involved in the more basic response of consuming it.

Finding a mate

Smell is also extremely important for reproduction of fish, so much so that many fish are unable to mate altogether if they have lost their sense of smell. Mating is greatly facilitated by the use of sex pheromones. These are chemicals released by the individuals themselves to indicate their identity, social standing, and reproductive

CONTINUES ON THE NEXT PAGE »

The location and number of nostrils can vary between different species. Here the nostril is in front of the eye.

A fish's memory also aids its survival, as shown by the case of minnows. *PHOTO COURTESY CARLO MORELLI - FORUM NATURA MEDITERRANEO & ETRUSKO25.*

Fathead minnows alert each other to danger by chemical means. *PHOTO COURTESY ENZIARRO.*

intentions. In the complex environments in which fish live, finding a mate of the appropriate age, sex, and reproductive status can be difficult so that even species that usually rely significantly on vision revert to olfaction when it comes to mating.

The first bit of information that such pheromones need to convey is the species of the individual. This is necessary to ensure successful breeding within a single species and avoid mating attempts between related species. Some fish are further able to recognise their relatives based on the pheromones exuded by others. This ability is very useful in avoiding inbreeding and choosing an appropriate mate. Female Guppies for example do not necessarily choose the mate that is visually the most attractive, but also take into account the mate's olfactory compatibility, as far as they are concerned.

A two-way process

Most fish are able to determine the reproductive state and value of a potential mate. This enables them to invest their time in wooing mates that are able and ready to mate, while avoiding the wrath of an unavailable, harassed female. Time and energy are precious, especially for species with restricted mating periods, so avoiding courtship attempts that will be unsuccessful greatly increases the likelihood of successful reproduction.

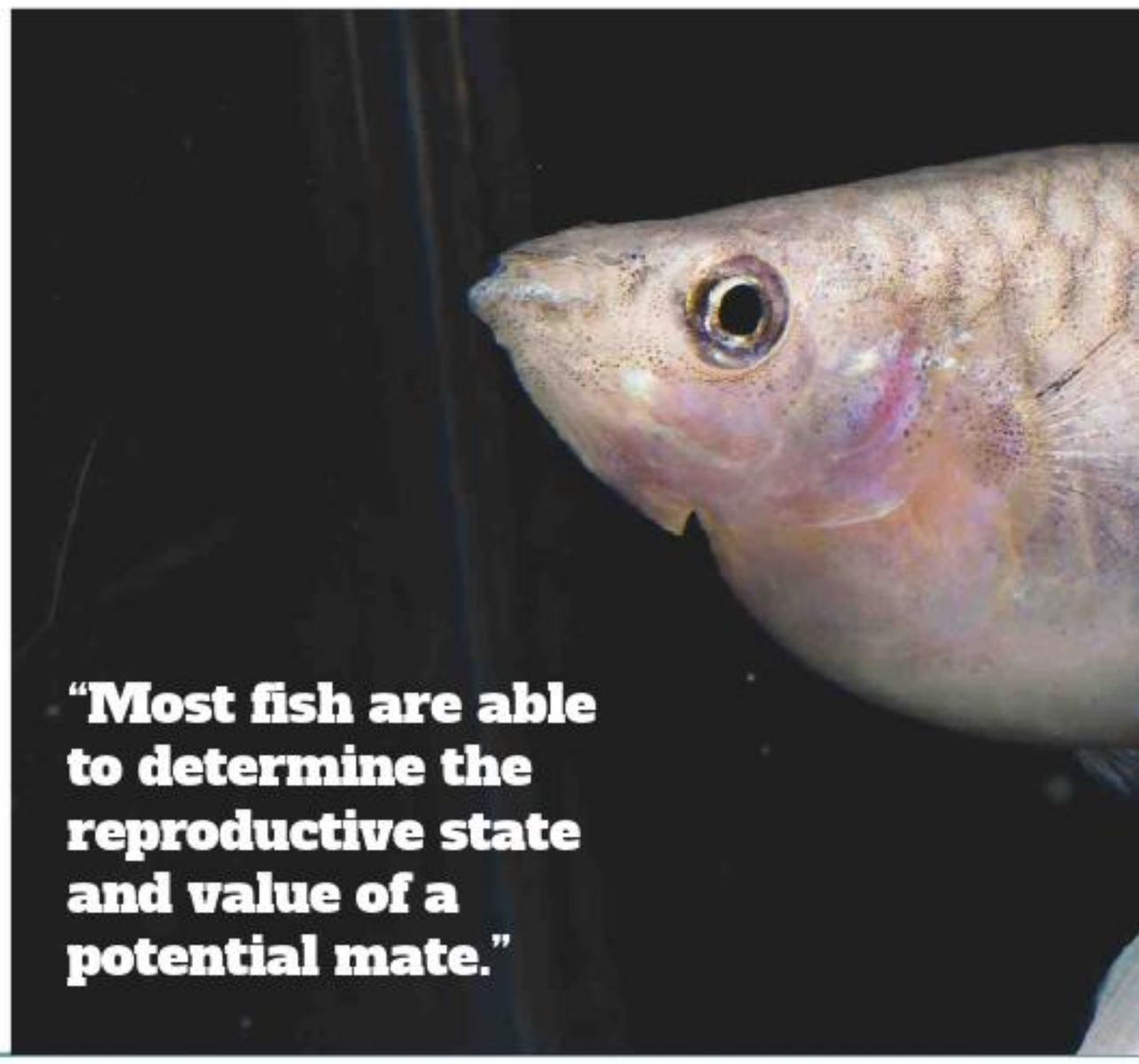
Furthermore, choosing an appropriate mate is closely linked to reproductive success, so that females tend to use chemical cues to determine the value of a suitor. As an example, female sheepshead swordtails (*Xiphophorus birchmanni*) choose well-fed mates over food-deprived ones, based on the chemical cues these males release.

The females do not make this distinction when choosing their female companions. This suggests that they are indeed targeting the reproductive benefits of well-fed males. These are likely to include good sperm quality, a high sperm count and lower rates of sexually-transmitted diseases.

The impact on parenting responses

In fish that provide dedicated parental care, such as the jewel cichlid (*Hemichromis bimaculatus*) from West Africa, olfaction is particularly important as it helps trigger appropriate responses. When these fish are separated from their young but the smell of the young remains in the water, they continue the same parenting behaviours as if the young were still present. If the smell of the young is suddenly transferred to a new location, the parents transfer their parenting behaviour towards their imaginary young in the new location.

Interestingly, the relative importance of smell versus vision changes though, depending on what the young are doing. Within their spawning pit (a hollow dug in the substrate), smell seems to be of overwhelming importance but when the young are swimming at a greater distance from the adults in open water, vision becomes the primary sense of recognition. For fish living in relatively clear water that allows parents to see their young over longer distances, this adaptation might be very useful, as conversely, the precision of recognition by chemical means reduces with distance. This is because the concentration of scent in the water becomes more diluted.



"Most fish are able to determine the reproductive state and value of a potential mate."

Scent plays a very important role in the parental care displayed by jewel cichlids. *PHOTO COURTESY ZHYLA.*

Detecting predators

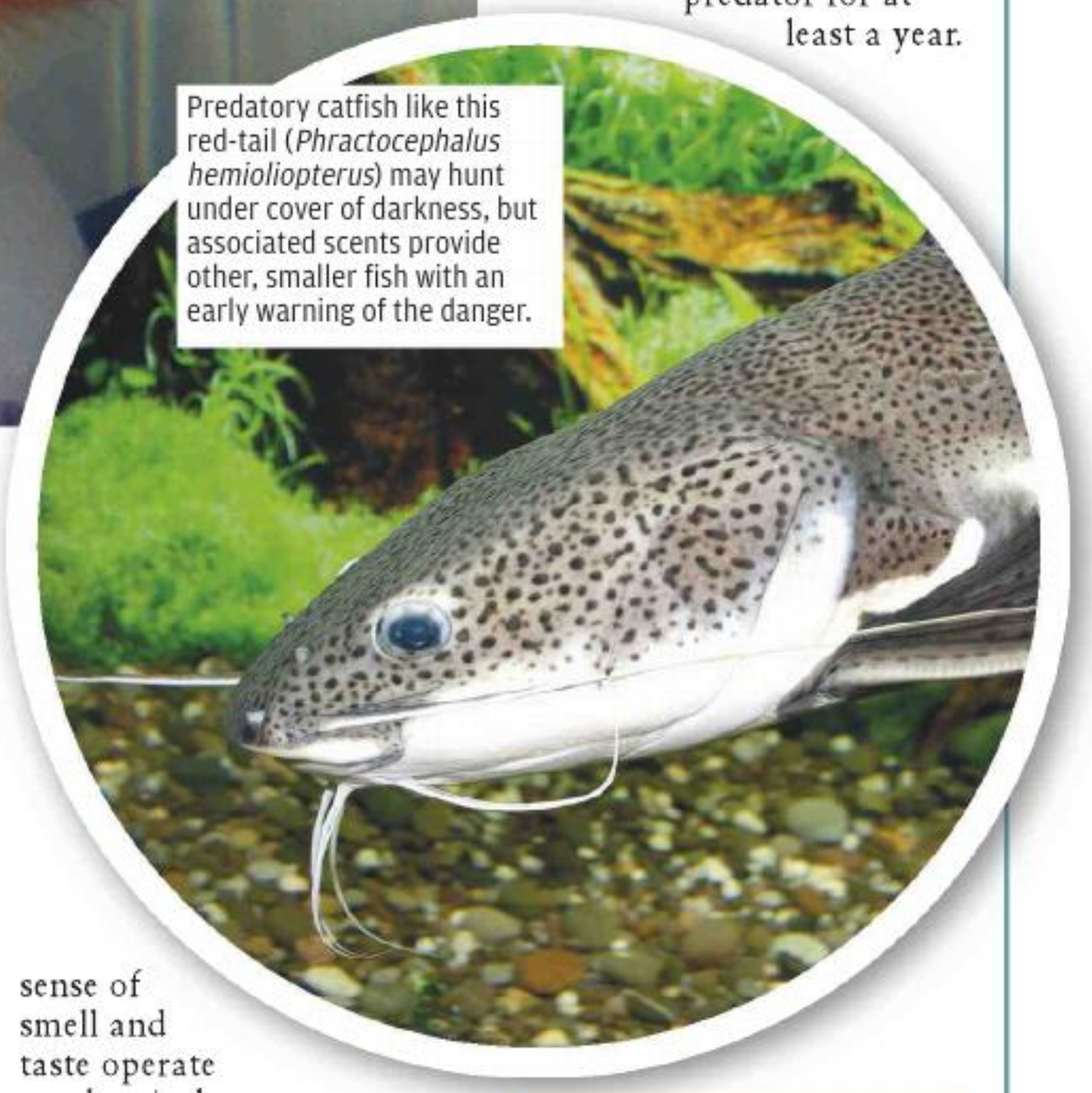
Chemicals also play an important role in the avoiding predators. Many fish may not only perceive the scent of the predator itself, but can also pick up warnings of danger coming from other fish of their kind, through chemical messages. A particularly strong stimulus of this kind is that released by fish that have been injured by a predator.

The importance of the olfactory system in avoiding predators was shown in a study comparing fathead minnows (*Pimephales promelas*) with and without a working sense of smell. The sense of taste was intact in all fish when they were exposed to the chemical cues of a predatory fish. Those with an intact sense of smell responded, while the ones with the impaired sense of smell did not.

This reveals that the sense of smell is very important in this species. While both the sense of smell and taste operate on chemical cues dissolved in water, taste was insufficient to warn the minnows away from the predator. This again shows that the sense of smell is likely to bring a wider range of benefits than the sense of taste.

It also appears that a fish can learn the danger indicated by a particular smell through observing the reaction of other fish. So a chemical that had no meaning to a specific individual can therefore be turned into a fearful stimulus if it is associated with fear-inducing chemicals or fear reactions. After being exposed to the combination of the neutral stimulus with the dangerous stimulus, fish are then likely to react with fear to the previously neutral chemical. They might thus be able to remain safe when a predator is in their vicinity.

The ability to learn such clues is beneficial, because it means that fish can adapt quite quickly to shifts in their ever-changing environment, such as the introduction of a new type of predator. This type of learning can be very long lasting. Minnows (*Phoxinus phoxinus*), for example, have been shown to remember information learnt about a predator for at least a year.



Predatory catfish like this red-tail (*Phractocephalus hemioliopterus*) may hunt under cover of darkness, but associated scents provide other, smaller fish with an early warning of the danger.

A female Guppy will not be attracted just by the appearance of the male.

Further discoveries lie ahead

Finally, it should be mentioned that although it is clear that the senses of smell and taste play a very important role in the behaviour of fish, very little is known about the exact chemical substances and their precise compositions involved in the context of these behaviours. Given that individual learning plays a big role, and as fish are an exceptionally variable group of vertebrates comprising a vast variety of species, it will be a long time before the mysteries of the fish chemical senses are fully unravelled.

USA AQUARIUM

The world of aquariums

Here, in this new series of articles, we look at public aquariums both in this country and abroad. **Dick Mills** begins by reporting from the Mile High City – Denver, Colorado.

You may think that one Mile High Aquarium would be enough for most people but, for those living in the dizzy heights of Denver, they have gone further and have two! One is the stand-alone Downtown Aquarium, located in this part of the city, next to a roller-coaster pleasure park, while the other forms part of Denver Zoo, hidden away behind the façade of the Tropical Discovery house. Surprisingly, there is not a lot of duplication occurring between the two, which makes visiting both of them a new and worthwhile experience.

As you can see, from the entrance, 'Aquarium – an Underwater Adventure' looks as if it means business and, once inside the building, you are left in no doubt that this is the case!

The first fish you see are in an enormous tank which, handily, sits adjacent to (and forms one wall of) the restaurant – a good enough place to start as any!

Soon, you are into your first experience – whilst looking at several separate collections of North American fishes you are given a sudden reminder of the dangers of flash flooding, especially startling in normally arid desert areas, and many an unsuspecting visitor got a mild drenching!

The usual tropical rain forest-type habitats are well represented. There was even a pair of live tigers above a tropical pool!

There were areas of coastal lagoons and nearby coral reefs, made all the more realistic by the merging of large photographic dioramic backgrounds with the large, well-lit shallow displays in front.

A violent display featured marine fishes that live in the surge areas, and it was quite obvious that these fish felt right at home as thousands of gallons of water were emptied into their tank every few minutes.

Children found it a thrill to be able to pop under the displays and stand up with their heads enclosed in a perspex bubble right next to some huge, ugly grouper!

Everywhere, there was excellent signage giving full details of the species on display, their habitats, lifestyles and dietary requirements.

"A violent display featured marine fishes that live in the surge areas"

At the zoo

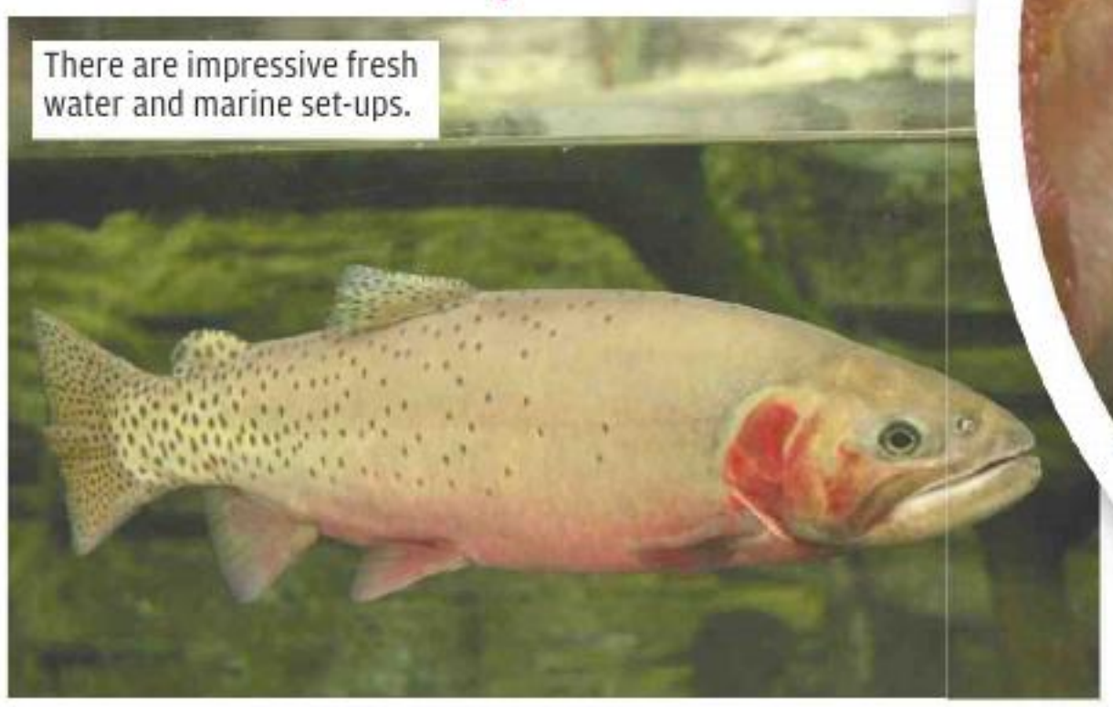
The display in Denver Zoo seemed to border on the more bloodthirsty side of things. Unlike our zoos in the UK, the authorities do not ignore the fact that most animals form part of a large food chain.

Reptiles and amphibians are openly fed live foods and

The restaurant with an aquarium forming a wall.

Inside the aquarium

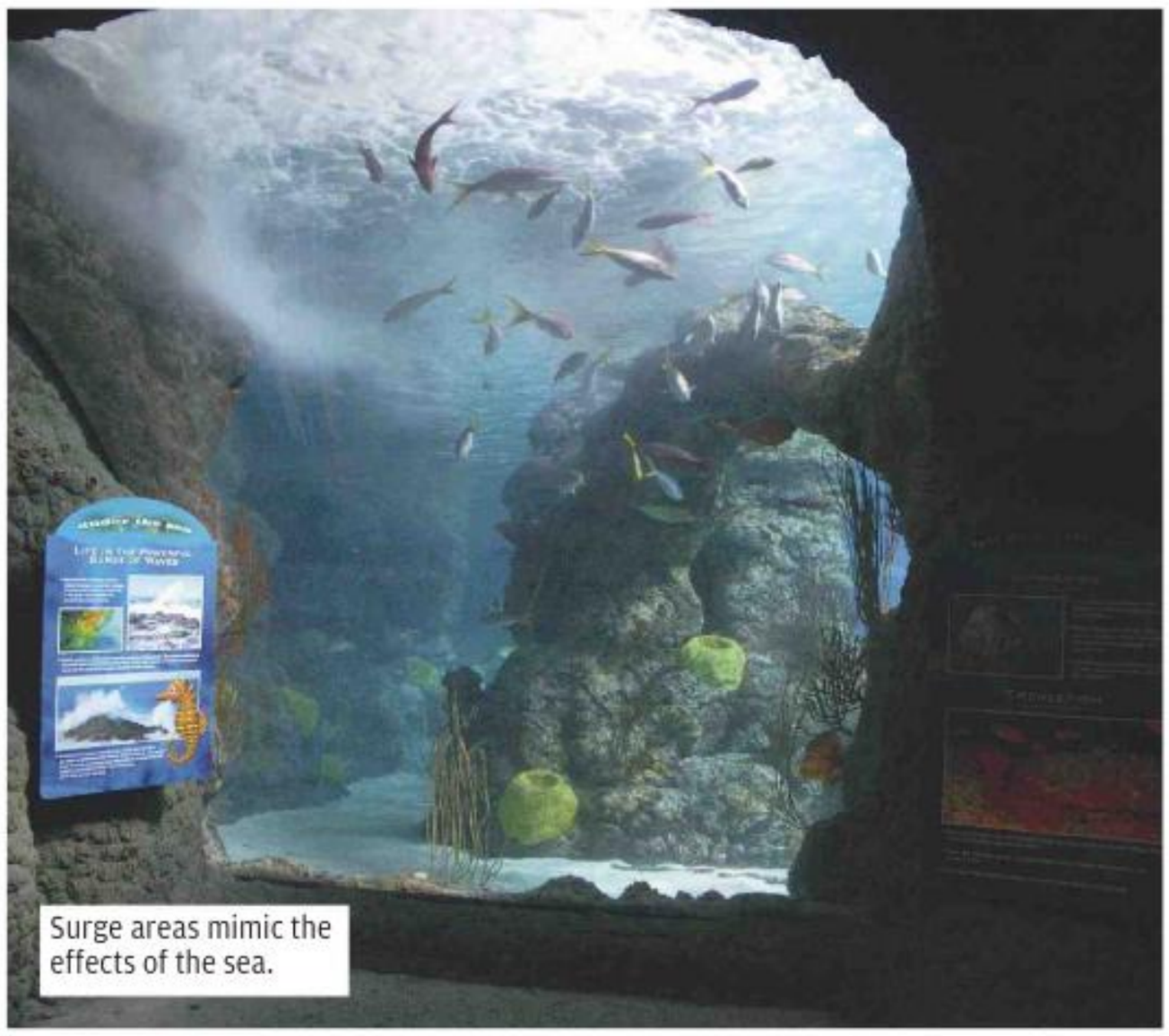
ALL PHOTOS BY THE AUTHOR


There are impressive fresh water and marine set-ups.


A huge sea anemone on view.


A grouper rests on a viewing dome.


Garfish.


Surge areas mimic the effects of the sea.


Some fish looked very strange!


A yellow-faced jawfish.

seeing a large chameleon stalk an unsuspecting locust held visitors' attention for several "will he, won't he get it?'" minutes. (Just for the record, he did!).

Elsewhere, mudskippers rolled their eyes in their sockets as they basked on a sandbank, and hordes of clownfish zoomed in and out of some of the largest sea anemones that you are ever likely to see.

The diversity of fish on view was tremendous – ranging from big cichlids (which were actually small compared with the arapaima in the tank) to strange bottom-dwellers and a very unafraid yellow-faced jawfish which spent as much time outside its burrow as in it!

Finally, outside in the zoo itself, there was the strange sight of lions playing quite happily outdoors in snow.

You could even get up close to these big cats, being only separated by a thick sheet of plate glass!

Further information

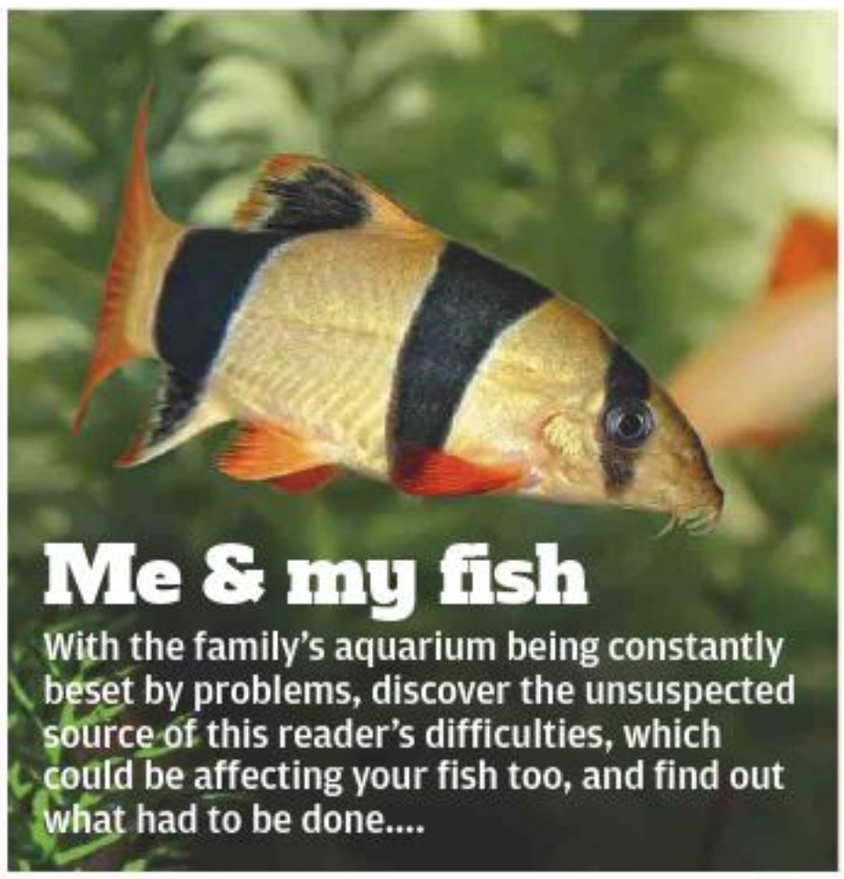
Denver Zoo
www.denverzoo.org
Downtown Aquarium
www.aquariumrestaurants.com/downtownaquariumdenver/visitorInfo.asp

Next issue

NOV/DEC EDITION ON SALE 18 OCTOBER

Types of tank

With aquariums being created in an ever-expanding range of designs, how significant is the type of tank that you choose for your fish, and where in the home you position it? Be prepared for some surprises!



Me & my fish

With the family's aquarium being constantly beset by problems, discover the unsuspected source of this reader's difficulties, which could be affecting your fish too, and find out what had to be done....

Magnificent mollies

These livebearers used to be one of the most popular of all aquarium fish, but their popularity has faded somewhat since the turn of the century. It's time to look at them again through fresh eyes, argues Don Harper.

Puzzle page

WHICH FISH IS THIS? Can you identify these five fish from these different parts of their bodies?

1. Butterfly fish 2. Botia macracanthus
3. Discus 4. Mexican fire-mouth cichlid
5. Red sailfin molly

PUZZLE IT OUT SOLUTION

Across: 1 Peppered, 5 Cory, 9 Nappy, 10 Flatter, 11 Flatter, 12 Panda, 13 Throbs, 15 Anthem, 18 Motto, 20 Pyjamas, 23 Drizzle, 24 Loose, 25 Yolk, 26 Shrieked.

Down: 1 Punch, 2 Popular, 3 Egypt, 5 Effort, 6 Often, 7 Yardarm, 8 Happen, 13 Timidly, 14 Bronze, 16 Hammock, 17 Speech, 19 Trial, 21 Julii, 22 Speed.

ID PARADE ANSWER

This is a an Asian glass catfish (*Kryptopterus bicirrhis*), whose range extends from eastern India via Thailand to Sumatra and Borneo. These fish grow to about 10cm (4in) long and inhabit fast-flowing streams.

PLANT LIFE ANSWER

This missing word is LIMNOBIUM

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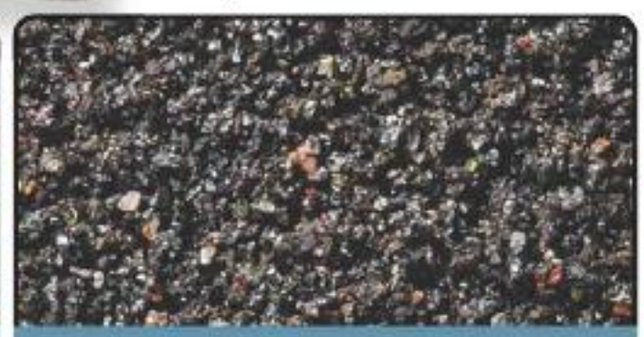

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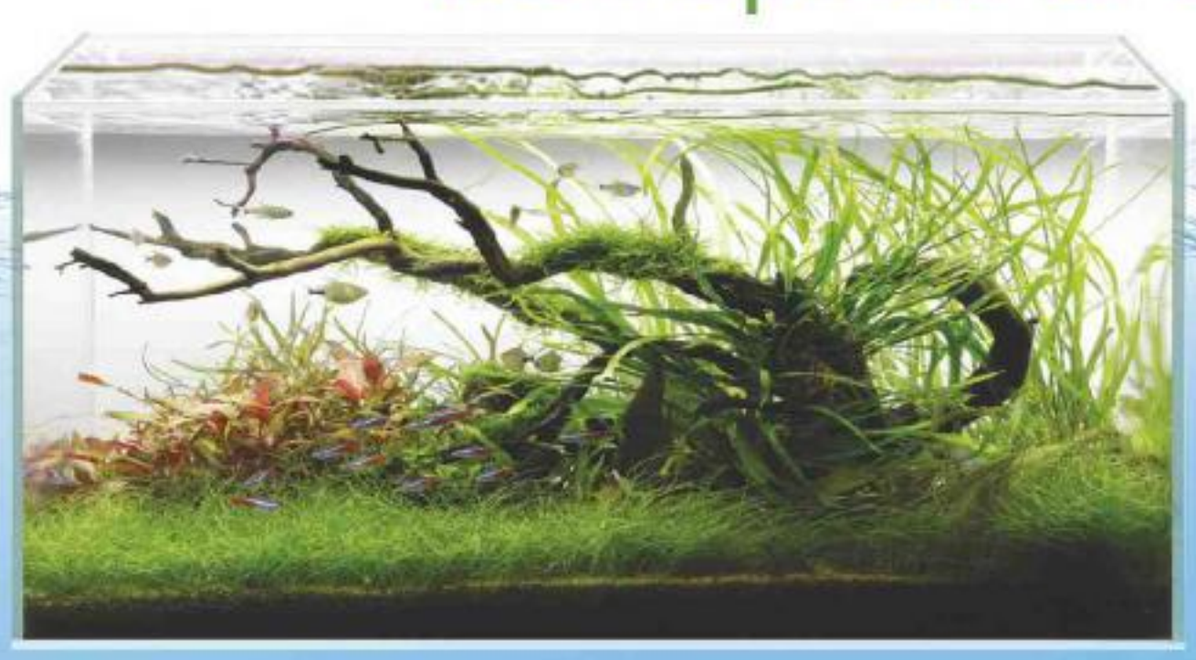

All tank photos courtesy of George Farmer

TMC Aquarium

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