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# hello

Well, the nights are drawing in again, and autumn is definitely here. I always think there is something particularly satisfying about having an aquarium to enjoy at this time of year, through the winter. Whatever happens with the weather outdoors, there is always a sunny, tropical spot that you can enjoy in your home!

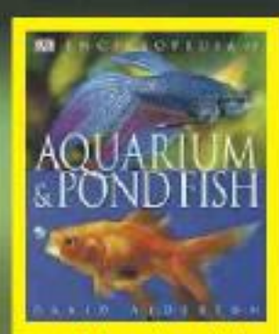
Perhaps not surprisingly, especially to fish keepers themselves, there is now plenty of evidence to show that the hobby really does provide a positive means of helping to address feelings of depression – whether seasonal or more general. Watching fish is also relaxing. It's not a coincidence that you can come across aquariums in potentially stressful locations, such as dentists' waiting rooms.

This isn't just a feeling either – it's been backed up by serious scientific study! Measurements taken of people observing aquariums have revealed changes in key physiological indicators, such as a lowering of blood pressure, which confirm that fish keeping really does reduce the significant signs of stress.

These findings also provide further evidence to support the theory that we, as a species, have a fundamental need to connect with nature. This is now described as biophilia, and serves to explain why we keep fish and other pets for example, as well as flocking to public aquariums and fish shows too.

In Japan and other parts of the Far East, the benefits of fish keeping are still more widely appreciated than is the case in the UK. The aquarium is not just confined to the home but can frequently be seen in offices too, assisted by the rise of the small nanotanks that will sit neatly on a desktop. These units represent a microcosm of nature, whether occupied by small fish, shrimp or other invertebrates, or simply just plants.

Do you find that fish keeping helps you to combat the everyday stresses of life? Do you have an aquarium in your office? If so, I'd love to hear how you feel that you benefit from it. Please email me!




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.

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

THANKS TO WWW.SHUTTERSTOCK.COM FOR PHOTOGRAPHY

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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

# What do we have in common with shoaling fish?

Anna Greenwood next to the device used for the study, made from an old bicycle whee and other salvaged par :s. *PHOTO BY BO JUNGMAYER.*

How and why fish swim in schools has long fascinated biologists looking for clues to understand the complexities of social behaviour – including our own! Scientists at the Fred Hutchinson Cancer Center, based in Seattle, have been studying the behaviour of the three-spine stickleback (*Gasterosteus aculeatus*). They have discovered that two key components of schooling – the tendency to school and how well fish do it – are genetic in origin, with different genes being involved.

That's important, explains Dr Anna Greenwood, because it suggests that if researchers can identify the genes that influence the social nature of the fish, so they may be closer to understanding how genes drive human social behaviour.

"The motivation to be social is common among fish and humans," explains Dr Greenwood. "Some of the same brain regions and neurological chemicals that control human social behaviour are probably involved in the social behaviour of fish as well."

## Genes and behaviour

Greenwood and her colleagues have been studying sticklebacks for several years, with the aim of understanding why the natural behaviour of these fish varies significantly. In a previous study involving marine sticklebacks from the Pacific Ocean, they found that Japanese fish schooled strongly, while a second group from a lake in British Columbia preferred hiding away, and were less able to maintain the precisely parallel formation required for schooling.

Although both groups were raised in identical laboratory conditions, they behaved differently from each other when placed together in a schooling situation. "That really suggests there's some kind of genetic factor controlling this difference," says Dr Greenwood.

This time around, the researchers used hybrids of the strongly schooling, saltwater-dwelling marine sticklebacks and the schooling-averse sticklebacks that live in freshwater, which again were raised in the laboratory. Dr Alison Bell, an associate professor of animal biology at the University of Illinois, Urbana-Champaign, said the linking of behaviours to different genetic areas in the same species – and in particular, social behaviour that depends on the behaviour of others – makes the results of study especially important.

"I think that's very significant," she says. "It's been hard to find regions within genes that are associated with any kind of behavioural traits in natural populations. Behaviour is very plastic and it's subject to environmental influences, so it's been really tricky to do that."

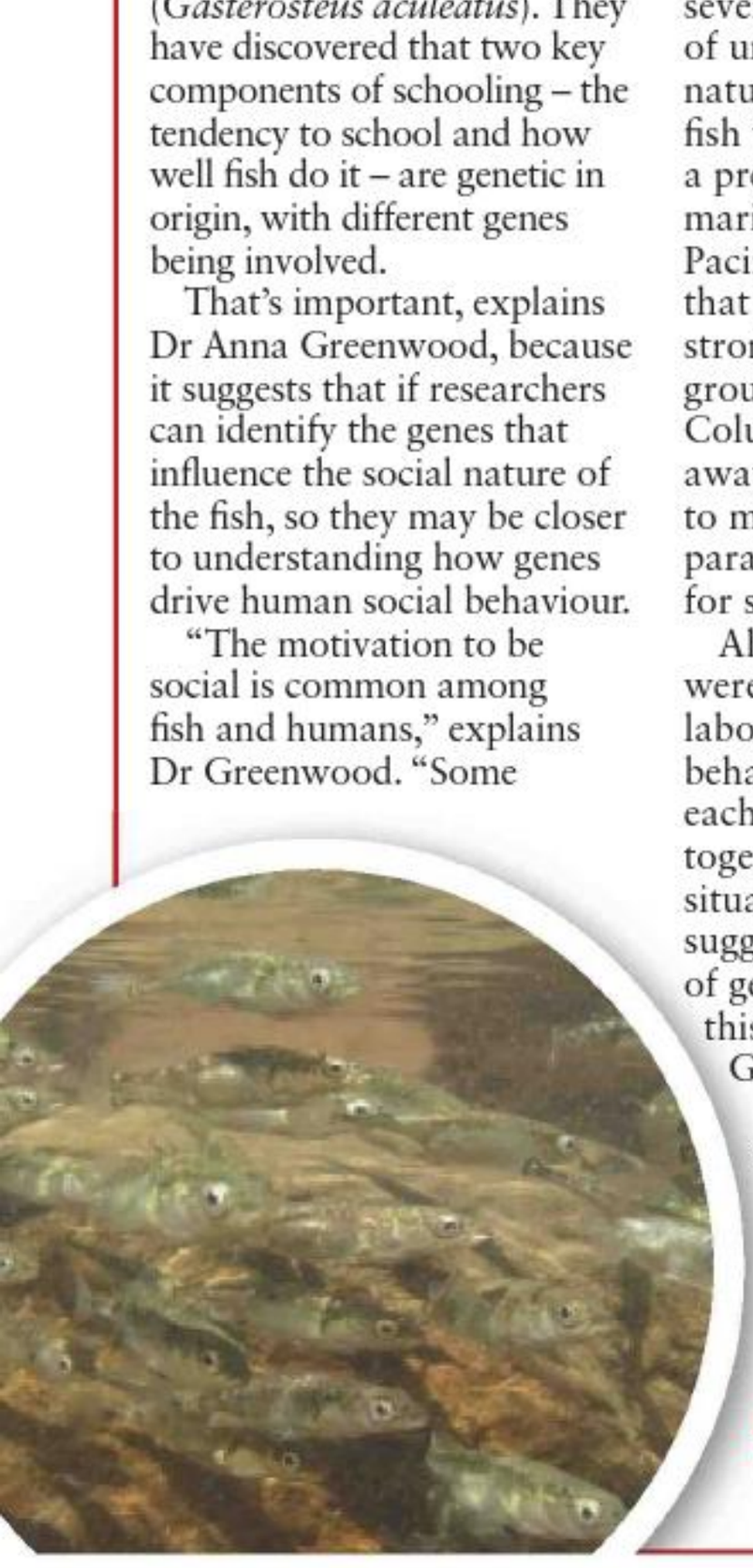
But the results could have much wider implications too. Prof Hans Hofmann, from the University of Texas at Austin, said the study also refutes the assertion that human behaviour is too complex to understand. "I think it shows that even such complex behaviours associated with other individuals, living in a very rigid and organised manner can be dissected genetically," he said. "Studies like this tell us that we might get there eventually."

## The role of an old bicycle wheel

Fish school primarily for protection from predators, and also to make swimming and foraging more efficient. Schools of fish in the wild are dynamic and fluid, but for both studies, the researchers had to create an environment in which they could observe them in unchanging conditions.

Building the device used for both experiments proved a challenge. The researchers suspended an old bicycle wheel above a circular acrylic tank and found a motor from an old lab shaker that could turn the wheel, but then were stumped about how to connect them. Greenwood and co-author Abigail Wark scoured craft shops and hardware stores looking for a suitable part, trying everything from plastic bra straps to necklaces, before finding some silicone tubing that worked.

"It was a few weeks of going around to shops,"



**LEFT** Three-spined sticklebacks swimming together in the wild. *PHOTO BY THOMAS P. QUINN.*

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admits Dr Greenwood. They made a mould to create model fish from resin tinted with grey pigment, dabbing on eyes with black paint to make them look more realistic. The eight models (this is apparently the minimum number needed to get fish to school in a laboratory setting) were suspended from the bike wheel with wire.

### The role of the lateral line

The study also found that the same regions of the genetic code appear to control both the stickleback's ability to school as well as the anatomy of its lateral line - a system of organs that detect movement and vibration in water, and contain the same sensory hair cells as found in the human ear. That suggests a single gene could cause fish to detect their environment differently and supports the

**ABOVE** The lateral line can be clearly here in close-up, extending along the fish's body.

long-held belief that schooling behaviour is controlled in part by the lateral line. It provides a promising starting point in trying to locate the gene involved, and the team is now working on manipulating the gene they think causes changes in the stickleback's lateral line, to see if that alters the schooling behaviour of these fish.

**Info at a glance**
Anna K. Greenwood, Abigail R. Wark, Kohta Yoshida, Catherine L. Peichel. Genetic and Neural Modularity Underlie the Evolution of Schooling Behavior in Threespine Sticklebacks. *Current Biology*, DOI: 10.1016/j.cub.2013.07.058

# Another way to stretch a body!

The bodies of snakes and eels are elongated, slender and flexible in all three dimensions. This striking body plan has evolved repeatedly many times over more than 500 million years during the period that vertebrates have been on the planet.

This stretching of the body occurred in one of two ways: either through the elongation of the individual bones making up the vertebral column, which thus became longer, or through the development of additional vertebrae and associated muscle segments.

### A unique discovery

However, a team of palaeontologists from the University of Zurich headed by Professor Marcelo Sánchez-Villagra has now discovered that a third, previously unknown mechanism of elongation occurred during the early evolution of fish, as shown by an exceptionally preserved fossil from that era.

Unlike other known fish with elongated bodies, the

**ABOVE** A fossil of *Saurichthys curionii*. PHOTO COURTESY UZH.

vertebral column of this fish, known as *Saurichthys curionii,* does not have one vertebral arch per muscle block segment, but two, which is unique as far as is currently known. This resulted in the body of the fish becoming longer and accounted for its elongated appearance.

The fossilised remains of the fish come from the Monte San Giorgio find in Ticino, south-western Switzerland, which was declared a world heritage site by UNESCO in 2003. The researchers owe their discovery to the fortunate circumstance that not only the skeletal parts but also the tendons and tendon attachments surrounding the muscles of this primitive predatory fish had survived intact.

Thanks to the shape and arrangement of the preserved tendons, so the scientists have also been able to draw conclusions as to the flexibility and swimming ability of these fish. It appears that *Saurichthys curionii*'s body was not as flexible as that of today's eels and, unlike modern oceanic fish such as tuna, they were probably unable to swim for long distances at high speed. Based upon its appearance and lifestyle, *Saurichthys curionii*, which measured about 0.5m (1.6ft) in length, was probably most comparable to the garfish or needlefish that exist today.

**Info at a glance**
Erin E. Maxwell, Heinz Furrer, Marcelo R. Sánchez-Villagra. Exceptional fossil preservation demonstrates a new mode of axial skeleton elongation in early ray-finned fishes. *Nature Communications*, October 7, 2013. doi: 10.1038/ncomms3570

# Were you a winner in our biOrb® aquarium competition?

In our first issue, there was the chance to win one of three biOrbs, courtesy of manufacturers Reef One Ltd.. These modern and stylish acrylic aquariums have transformed the hobby, proving incredibly popular.

The first prize of a biOrb LIFE 30 litre, worth £237.58, was won by Anita Woodbridge from Aylesbury in Buckinghamshire.

The second prize of a biOrb CLASSIC 60 litre, worth £187.52, was won by Geoff Hale from Milnthorpe in Cumbria.

The third prize of a biOrb FLOW 15 litre, worth £94.45, was won by Denise Gray from Newcastle in Monmouthshire.

Many thanks to everyone who took part. The prizes will be with the winners shortly, but if you missed out, and would like to have a chance to win another aquarium, we will be running another competition in our next issue.

**Want to know more?**
You can find the entire the biOrb range on Reef One's website at www.biorb.co.uk



# Looking at barbs in a new way

It's a sad fact that some groups of aquarium fish are regarded as more fashionable than others, and unfortunately, for some reason, barbs have a rather dull reputation, being regarded largely as suitable only for a mixed aquarium, rather than species to specialise in. Yet as **Christian Castille** reports, they represent a diverse and very interesting group of fish.

Over the years, I've kept many species of barb, and have found them to vary greatly in terms of not just their husbandry, but also with regard to their natural behaviour. To me, they represent one of the most exciting and yet neglected groups of fish suitable for the freshwater aquarium.

There seems to be a view amongst many established fish keepers that barbs are not especially active, nor are they necessarily colourful, plus they can also be aggressive towards fish with trailing fins, meaning that their companions need to be chosen carefully in a community aquarium. All of these statements are not necessarily true though!

I really hope that this article might therefore cause you to look again at this group of fish, and see them in a new light. They offer plenty of scope for the specialist, as much as for the community tank, and a number of species are surprisingly colourful. Many barbs can often be persuaded to spawn quite readily too, adding another dimension to keeping them, if you are interested in breeding your fish.

Subtle colouration is a feature of various species, such as Synder's barb (*Puntius snyderi*).

## Starting out

My first experience with barbs came about accidentally, when I was 12. I had seen some lovely lemon tetras (*Hyphessobrycon pulchripinnis*) for sale in a shop, and when I returned to buy them with my older brother, we discovered that they had been sold. Nevertheless, we bought some fish that were rather similar in appearance. These were actually spotted barbs (*Puntius binotatus*), and within weeks, I was enjoying keeping them so much that I returned to see what other barbs the shop had available.

Rosy barbs soon followed (*Puntius conchonius/Pethia conchonius*) along with many others, yet perhaps surprisingly, based on their availability today, tiger barbs (*Systomus tetrazona*) were a later addition for me, because at that stage, the owner of the fish shop had difficulty in obtaining them. Since then though, I've always had at least one tank set up for tiger barbs. Over the years, I've now kept around 20 species of barb in total, and greatly enjoyed doing so - even being lucky enough to breed 12 of them successfully.

## What are barbs?

In fish keeping circles, the description of 'barb' can be used to refer to many different species, but this article focuses on those within the Cyprinidae family, often popularly described as cyprinids. This group comprises the largest number of fish species in the world, and it is also ranked as the largest of all vertebrate families.

Barbs form part of the sub-family of Barbinae, which also incorporates a number of related groups, including members of both the genus *Rasbora*, which are popular aquarium fish in their own right, as well as *Garra* species, which have become better known over recent years for giving people pedicures! Although there is still a lot of confusion surrounding the classification of barbs, the majority are currently classified in the genera *Barbus* and *Puntius*, although some have recently been transferred to the genus *Systomus*.

## Did you know?

The description of 'barb' comes from the Latin word 'barba', meaning beard. This refers to the sensory projections called barbels that may be evident around the lower jaw, helping to detect worms and similar food in the substrate.

## The initial discovery

The first ever *Puntius* barb was described right back in 1807, being recorded by Francis Hamilton (1762-1829). He was a Scottish doctor who worked for the Governor General of India, but his love of animals was such that in his free time, he established his own zoo, which still exists today in the city as the Alipore Zoo. It is thought to have inspired Sir Stamford Raffles to found London Zoo, after he visited the collection in 1810.

Barbs look very impressive in a planted aquarium.

What is interesting about Francis is after his mother died in 1815, he took her surname of Hamilton, although prior to this, he was known simply as Francis Buchanan. This has created some confusion, because all botanical findings are recorded under the name of Buch-Ham, whereas his zoological discoveries are recorded as Hamilton.

Francis Buchanan-Hamilton helped to pioneer the early descriptions of *Puntius* species, creating a large group of fish. He is credited with discovering 18 different barbs in total. The first species that he found was the Curmuca barb (*Cyprinus curmuca*), although its name later changed to *Hypselobarbus curmuca*, which is still considered as its accepted name today.

## Other pioneers

Apart from Francis Hamilton, there are some other well-known scientists who are noted for their work helping to form the barb grouping of today. They include Pieter Bleeker, a Dutch doctor, who described a further 29, which is not so surprising perhaps, when you realise that during his free time in south-east Asia, he collected over 12,000 individual fish specimens. Later, Albert William Herre described 19 species in 1924.

Albert Gunther (1830-1914) reported an impressive 18 species, while working mainly in the field of reptiles, as did Achillie Valenciennes (1794-1865). His work continued that of his late friend and colleague Georges Cuvier, as he completed a 22 volume set of books entitled the *Histoire Naturelle des Poissons*, which was the leading work of its kind at that stage.

Yet out in front, in terms of the discovery of barbs, is Francis Day (1829-1889), an English-born Indian fisheries manager. During his lifetime, he described over 1400 species of fish, of which 36 of them were barbs from the *Puntius* genus. Day was something of a maverick though, and made enemies along the way. In particular, his decision to sell his collection of fish to the Australian Museum, rather than to the British Museum, upset the scientific establishment at the time.

Yet one of the main reasons that I am a big fan of Day is because he was not just a taxonomist, interested in naming fish and unravelling

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**ABOVE** A torpedo-like body shape is a feature of many barbs.

Pieter Bleeker (1819-1878), a pioneer in the field of barbs.
*PHOTO COURTESY HOLTHUIS COLLECTION, NATURALIS*

Albert William Herre (1868-1962) was an American who spent much of his working life describing the fish fauna of the Philippines. *SOURCE: PD*

their relationships. He wanted to know more about them. He was a true animal lover, so much so that he too set up what was effectively his own private zoo. It was home to over a wide range of animals, including over 200 species of live fish that he would often breed. This was at a time long before it was possible to keep them in heated aquariums in Europe and North America.

## The tiger is top!

Today, the most widely kept of all the barbs is without a doubt is the tiger barb. Over 2.6 million are being sold annually in the USA, making it one of the Top Five most popular aquarium fish. The trouble is that if you are really into tiger barbs, then you may be left scratching your head as to what exactly you have in your aquarium.

The genus of this species is constantly being changed, new species are constantly being referred to as 'the' tiger barb and the original form of the tiger barb is even in question. Some references describe the common tiger barb as *Puntius tetrazona* or *Systomus tetrazona* but the real confusion comes from the fact there are actually five described species of tiger barb!

Unfortunately, none of the aquarium-bred tiger barbs match any of the scientific descriptions of these fish, not even their own namesake, which has left most of the aquarium community wondering what exactly they have swimming in their tanks. It is possible that tiger barbs being bred today are effectively derived from several different ancestral forms, modifying their characteristics as a result. Until this complicated state of affairs is clarified, most taxonomists prefer to use *Puntius tetrazona* as the official description for these barbs.

## Care needs

Barbs differ in the care that they require, but they all tend to be hardy fish that will thrive in your care, even if you have not kept fish before, with their needs being quite straightforward in most cases. Yet despite this, they are noted for being aggressive and not regarded as ideal fish for communal setups. Much of this reputation stems from the tiger barbs, and while it is true they can be aggressive around other fish, making it seem that they are unsuitable for communal setups, this is not actually the case.

Unfortunately, what tends to happen is that barbs are sold in large numbers, and mostly to people who little experience of fish keeping. Tiger barbs look attractive and are relatively cheap too, making them appealing to those taking up fish keeping. Unfortunately, shop staff may not always provide the correct advice about these fish, and it is this combination of ignorance that leads to problems.

The truth of the matter is that tiger barbs are excellent fish to keep, not just in a single species aquarium but also as part of a communal setup. They do make ideal starter fish if you are new to the hobby, but their nature needs to be fully appreciated, in order to avoid problems. These schooling fish have a justified reputation as fin nippers, especially when kept in the company of those with trailing fins, such as male Siamese fighting fish (*Betta splendens*), but this relates to the number of barbs being housed together.

They are highly social fish by nature, living in relatively large numbers, and most beginners do not acquire enough of these fish to set up a self-contained school. As a result, occurring in smaller

Shoal size is very important in terms of maintaining harmony, when keeping tiger barbs.

The natural green form of the tiger barb. This is a popular variety today.

A red tiger barb. Care needs to be taken when buying coloured forms of this fish.

**"If you start with a group of ten, then you should not find that you have a problem with fin nipping, as the barbs will interact with each other."**

numbers, so they then tend to interact more with other tank inhabitants than their own kind. Even though tiger barbs have been widely kept in the hobby for some 70 years now, this knowledge is not widely shared. If you start with a group of ten, then you should not find that you have a problem with fin nipping, as the barbs will interact with each other.

When it comes to their appearance, barbs are not necessarily thought of as being brightly coloured, but again, this depends on the way that the fish are being kept. In a well-lit aquarium with little cover, so they will appear to be pale and washed out. Yet on the other hand, if you transfer these same fish to more shaded surroundings, you will see their natural colouring is actually quite strong in many cases, albeit subtle.

## Take care!

Particularly barbaric practices have been used in the Far East to enhance the colours of these fish, with a view to enhancing their appeal to unwitting consumers. This can entails the injection of a dye into their bodies, causing an albino individual to appear red in part, as in the case of the so-called strawberry tiger barb.

Another method entails dipping the fish in a mild acidic solution, which strips off the fish's invisible coating of protective mucus, so that it can then be painted with a fluorescent dye, and given further treatment, to trigger renewed secretion of this mucus.

Thankfully, all responsible retailers in the UK boycott such fish, whose lifespan is likely to be seriously curtailed by such treatment. On the other hand, there are also naturally bred colour variants that are striking, and have been carefully cultured in the hobby for over half a century now. These include green tiger barbs, pieds, orange, yellow (leucistic) and albino strains.

## Water concerns

The water chemistry needs of barbs do vary, depending on the species concerned. In the case of tiger barbs and the majority of species though, they prefer soft and slightly acidic water conditions, and are reasonably adaptable as far as water temperatures are concerned. Check the precise requirements though, for any species that you are planning to acquire. If you hope to breed these fish, water conditions assume greater importance.

## Breeding tiger barbs

The breeding needs of these fish is similar to that of most of the related species. You may even be lucky enough to breed these fish in a communal tank, as my godchildren have done, in the company of various plecs (plecostomus catfish). However, if you wish to have more control over the process, and obtain more young, then you need to set up a spawning tank for them.

I use a fine mesh net raised slightly off the floor of the tank, so that the majority of the eggs should fall though here, out of reach of the fish as they will otherwise eat them. Some breeders line the base of the spawning tank with a couple of layers of marbles, which will also protect the eggs.

Keep the adults well-fed, and increase the quantity of live food in their diet, in order to trigger spawning behaviour.

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Cherry barbs display attractive colouration.
*PHOTO COPYRIGHT PHOTOMAX AT THE GOLDFISH BOWL, OXFORD*

A so-called albino cherry barb. These fish are more brightly coloured than the normal form.
*PHOTO COPYRIGHT PHOTOMAX AT THE GOLDFISH BOWL, OXFORD*

The females will then start to swell with eggs at this stage, while the males will start chasing and nudging them as a prelude to spawning.

I aim to keep the pH of the water about 7.0 at this stage. Once spawning has occurred, transfer the adult fish back to the main tank, and then wait for the young to hatch. This should take place within about 24 hours, although as usual, the fry will take about a couple of days to absorb their yolk sacs and start to become free-swimming.

They can be reared quite easily on fry foods, but be prepared to carry out frequent water changes to maintain water quality, as the young barbs start growing, and do not overfeed them, as uneaten food will pollute the water, endangering their health.

## Other choices

The following species of barbs are also popular in the hobby, and help to illustrate the diversity that exists within the group.

### Cherry barb (*Puntius titteya*)

These small, slow-swimming fish are so-called because of their colouration, with males being a much darker

Tinfoil barbs are very elegant, streamlined fish.

A Denison's barb.

cherry-red shade than females. They grow to around 5cm (2in) and are considered to be docile fish, certainly compared with tiger barbs, but I have found that other fish with long fins sharing their aquarium do attract their attention and fin-nipping may occur.

Cherry barbs are surprisingly adaptable fish that regularly breed in communal setups, with females depositing small clusters of several eggs on leaves or décor in the aquarium, although the chances of breeding success in these surroundings are low, as the other fish are likely to eat their eggs or any fry that do manage to hatch successfully.

**"These fish are very beautiful to my eye, and yet very underrated, as reflected by the fact that they are not widely available."**

### Tinfoil barb (*Barbonymus schwanenfeldii*)

Do not be fooled by this elegant, sleek, silvery species.

A group of gold barbs makes an impressive sight.

Although widely offered for sale, these fish are very atypical, compared with most other barbs, simply because they will grow to a large size, typically in excess of 30cm (12in), and need a suitably spacious aquarium. Good filtration is also very important, as they produce a lot of waste, and they like to swim in water with strong currents. Tinfoil barbs prefer relatively cool water, around 23°C (73°F) and a pH of about 6.0. Although they prefer to be kept in groups, they tend not to breed easily in the home aquarium.

### Gold barb (*Puntius semifasciolatus*)

These fish are very beautiful to my eye, and yet very underrated, as reflected by the fact that they are not widely available. In the trade, they are more likely to be called '*Puntius schuberti*', although this is not a valid scientific name. What

CONTINUES ON THE NEXT PAGE »

Ruby barbs are similar to tiger barbs, and have similar care needs.

PHOTO COPYRIGHT PHOTOMAX AT THE GOLDFISH BOWL, OXFORD

happened is that back in the 1960s, American fish breeder Thomas Schubert created a golden mutation of the fish that he then selectively bred to improve its look.

Schubert then decided to name this variety after himself, which gave rise to confusion when it was being sold, causing people to believe this was its scientific name. It then started to be called the gold or golden barb. In reality, these fish are a mottled green colour and ironically, this natural colour variant is now very rare in the hobby, and therefore fetches much more than the ornamental variety.

Gold barbs are not only attractive but peaceful by nature too, and they are easy to keep, being highly adaptable by nature. They seem to prefer to be in groups of five or more, and to be housed in an aquarium that is not densely planted. Breeding is very straightforward, and in fact, this is considered to be one of the easiest of all the barbs to breed.

## Denison's barb (*Puntius denisonii*)

A relative newcomer on the fish keeping scene, this species is stunning to keep in groups, as part of a display. The appearance of these barbs is surprisingly variable, particularly with regard to their red markings, which enables individuals to be distinguished easily. They occur in fast-flowing rivers in southern India, and are also described as red line torpedo barbs, reflecting the shape of their bodies.

Denison's barbs are more highly priced than most barbs but certainly worth it, in my view. They can sometimes be rather nippy with large finned species but tend to get on better with bigger fish than themselves. Captive breeding proved problematic for some years, but now, tank-raised specimens are widely available.

I have found that they tend to do better when kept with a sandy substrate, rather than gravel, and, as befits a species used to fast flowing water that sweeps away impurities, so weekly water changes up to 40% are recommended, meaning that this aspect of their care is more demanding than with many other barbs. They have been bred at Chester Zoo, and this experience helped to pinpoint the fact that large numbers must be kept together to trigger successful spawning.

## Black ruby barb (*Pethia nigrofasciata*)

This is a very colourful semi-aggressive species of barb that is readily available and has a very similar appearance to the tiger barb, although growing to twice the size. Personally, I really like these barbs. The sexes can be distinguished to some extent, with the females just showing hints of ruby colouration compared with males.

To my eye, they look like a much better version of a tiger barb, displaying an individual mix of black, red and silver flecking. They become less aggressive in larger groups and seem to get on well with other barbs. Breeding is exactly the same as for tiger barbs, but unfortunately, these fish do seem to live in the shadow of their better-known cousin, and may not be as easy to obtain. They thrive in acidic water with a pH of about 5.0.

## Rosy barb (*Puntius conchonius*)

I have to admit that these fish will always remain my favourites, offering almost every desirable trait that you could possibly want in an aquarium fish. They are very colourful and mix well with virtually every other non-aggressive type of fish if kept communally. Rosy barbs have been commercially bred over many generations for their rosy red colours, with females naturally displaying a more golden hue. However, males may darker in colour when spawning in some but not all cases, depending on their strain. There is now even a long-finned form of the rosy barb that is well-established in the hobby.

They are very hardy fish, and can grow to a size of 9cm (3.5in) making them an attractive if slightly large choice for a community aquarium. Once again, they should be kept in a group, but a school of five should be adequate in this case. Again, breeding corresponds to that of the tiger barbs. I have bred them regularly for a number of years now, and this process is reasonably straightforward. Also, I would say that this species generally appears to have more character

Two long-finned examples of the rosy barb, revealing their individual patterning.

A number of barbs display striped patterning. This is the red-striped *(Barbus bimaculatus)*.
PHOTO COPYRIGHT PHOTOMAX AT THE GOLDFISH BOWL, OXFORD

than other barbs, interacting regularly but not aggressively with many other species in a communal setup.

## Striped barb (Puntius trifasciatus)

This species is one of the rarer species in the hobby, being a relatively new addition to the list of barbs that are available, having only been discovered during 1996 in its Indonesian homeland. However, I was lucky enough to acquire a small group of 15 of these fish. They have some of the most beautiful camouflaged markings on their sides, with uneven patterning comprised of pale black lines running across their flanks. These seem to get deeper and bolder toward nightfall (or in dark surroundings), which may be a mechanism to help them avoid predation.

I keep them in heavily planted enclosures on their own, as their behaviour changed and they seemed to hide all the time when I introduced a few neon tetras into their tank. They also do not seem to want to eat flaked food, with mine only taking small live food such as brine shrimp. As far as I am aware, there has been no recording of them breeding in aquarium surroundings as yet. Nevertheless, I have seen my males exhibit breeding colouration, although no spawning has taken place.

## Fake clown barb (Puntius everetti)

These do not rank amongst the most commonly available barbs, but they can usually be sourced through a good specialist aquatic shop, particularly if you are patient. I like these barbs especially because of their similarity in appearance to corydoras catfish, which are a particular favourite of mine as well.

I acquired 30 adult fake clown barbs some years ago, and they are all still with me. They are very hardy fish, and they have spawned for me many times. Unfortunately though, their eggs have never hatched successfully. I am still trying to work out if this is something to do with the environmental conditions or my breeding stock.

Even just for display purposes though, I think these barbs represent a wonderful alternative to some of the common loaches that you often see for sale. In theory, they can grow to 10cm (4in), but my adults are only about 7.5cm (3in) long.

**"They are very hardy fish, and can grow to a size of 9cm (3.5in) making them an attractive if slightly large choice for a community aquarium."**

The clown barb.
PHOTO COPYRIGHT PHOTOMAX AT THE GOLDFISH BOWL, OXFORD

## Mascara barb (Dawkinsia assimilis)

Another reclassified species of barb I really had to include in this short list of barbs, as it is simply breathtaking and a truly beauty among fresh water fish. Now named after the evolutionary scientist Richard Dawkins, these barbs, were originally described back in 1849. While both genders are stunning in colouration, it is the males that are most flamboyant, assuming green hues, gold, red semi-circles and a black bold spot on a background of intense pearlescent white scales.

Mascara barbs sum up this group of fish in general for me. They are totally underrated, relatively hardy fish that are reasonably straightforward to breed. Peaceful in suitable schools, they are capable of leaving both new and experienced aquarists alike sitting front of their tanks watching them for hours.

ORNAMENTAL AQUATIC TRADE ASSOCIATION

There's advice on topics of all types for fish keepers on OATA's website.

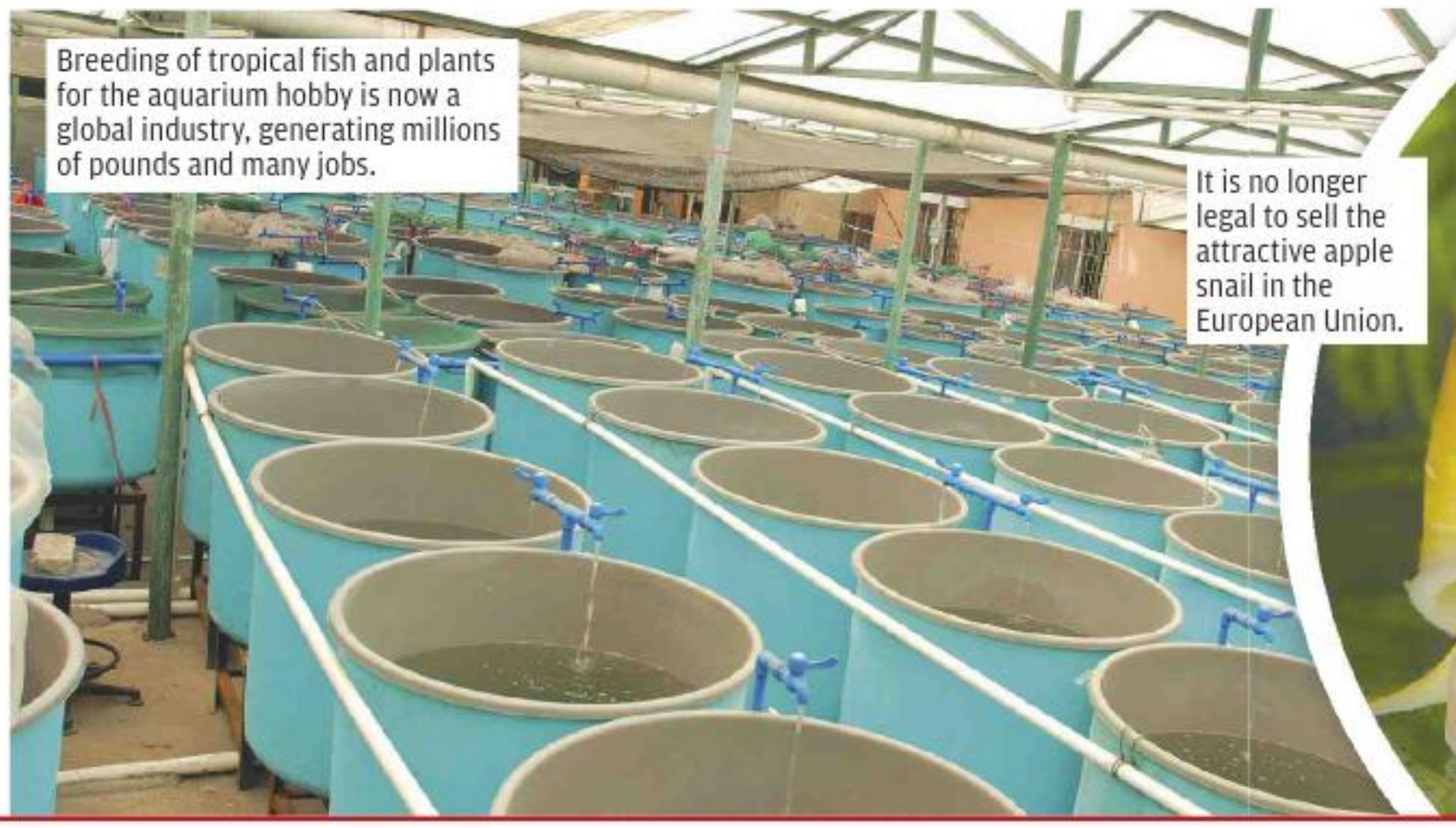
# Standing up for fish keeping!

Have you heard of OATA? These initials stand for the Ornamental Aquatic Trade Association. This organisation represents a wide range of businesses – from retail shops to wholesalers, importers, vets and pond consultants, all of whom work within the aquatic industry. **Pauline Davey** explains more about the vital role played by this trade association.

OATA's aim is to protect and promote the interests of its members, serving as the 'voice' of the industry in discussions with government and other bodies. Like you, we're passionate about the pastime of fish keeping, and recognise that everyone involved in this hobby needs to work together for its continued survival. There's plenty that keen aquarists can do to help us to ensure the survival of this satisfying hobby into the future, because there's no doubt that the ornamental aquatic industry is being challenged in some areas.

## What do we do to help you?

We recognise that fish keepers can sometimes need advice and information to find the best way to set up and maintain home aquariums and ponds, particularly when you first start out. So OATA has produced several 'how to' videos to help you set up aquariums and keep fish successfully. You can find these on YouTube by searching ornamental fish or our Facebook page if you're interested (facebook.com/oataltd). We've also written a wide range of care sheets for every fish you might want to keep – either ask for them at your nearest OATA retailer or visit the library on our website. And we've created a free 'troubleshooter' Android app to download to your smartphone which



Breeding of tropical fish and plants for the aquarium hobby is now a global industry, generating millions of pounds and many jobs.

It is no longer legal to sell the attractive apple snail in the European Union.

helps you find the answers to some of the most commonly encountered fishkeeping problems. Enthusiastic fishkeepers are usually keen to find new ways to master the intricacies of water maintenance. So we also offer training packages to help you get the most out of your hobby. We originally created the home-study courses for people working in the industry as a way of offering retailers an easy way to train their staff. But if you're a really keen hobbyist you might find the courses of interest as well. Our Certificate course covers four topics – water quality, filtration, fish health and fish biology – while the Advanced Diploma delves into these areas in more depth. You can find out more on our website at www.ornamentalfish.org/training

Water quality is a critical aspect of keeping aquarium fish like these discus healthy. OATA offers home-study courses for keen fish keepers.

## Representing fish keeping in general

The largest part of our job is making sure you still have fish, plants and products to buy to indulge your passion. A lot of what we do is monitoring and questioning, where necessary, the plethora of proposed global, European or national legislation that could have an impact on what appears on the shop shelves or in tanks for you to buy.

Much of our work is ultimately challenging the work of organisations wanting to stop the trade in non-native or exotic pets, such as fish. Indeed there's a campaign at the moment from one Brussels-based group lobbying against the trade and this campaign, if successful, would halt the sale of almost all ornamental fish – whether freshwater, tropical or marine. Fish keepers would probably be left with just tench, rudd, goldfish and koi to keep under these circumstances. That would effectively wipe out the industry – there's just not enough business surrounding these four species.

Last year we saw Europe bring in a ban on the sale of apple snails because of problems in Spain. During 2013, we've seen a plant ban from DEFRA, which will halt the sale of water fern *(Azolla filiculoides)*, parrot's feather *(Myriophyllum aquaticum)*, floating pennywort *(Hydrocotyle ranunculoides)*, Australian swamp stone crop also known as New Zealand pygmyweed *(Crassula helmsii)* and water primrose *(Ludwigia grandiflora)*. We've actually been urging OATA members not to sell these plants for nearly a decade, based on the risk they posed to the environment if they got into our waterways, and so this prohibition was good news as far as we were concerned.

On the other hand, it is largely because of our efforts that *Lagarosiphon*, water hyacinth and water lettuce continue to be available to people wanting oxygenating plants for their ponds. But these bans tell us that the hobby is under the spotlight and is increasingly being seen as a threat to native flora and fauna.

Another proposal that we've been fighting recently is over barley straw products. These popular pond products, which people use to control algal growth, were to be outlawed under the new Biocides Regulation, introduced in September. It seemed crazy to us – and the manufacturers we represent – that this product which uses natural processes to control algae should come under threat. Our persistent pestering about this issue has won a stay of execution while more research is now carried out into how the products work. So shops will still be stocking barley straw extract – for the time being at least – thanks to us.

## What can you do to help the hobby?

It is worth knowing about the bigger picture while you sit and enjoy the beautiful aquariums and ponds you've created. As an industry, we move more animals between more countries than any other trade. And because of this, the hobby is increasing being seen as a threat, mainly because of the potential for non-native plants and fish to become established in the British countryside.

So responsible fish keepers and pond enthusiasts have an important role in battling this supposed 'threat' and we'd urge you to play your part. One way to support the hobby you love is to look at how you dispose of aquatic plants. Google the *Be Plant Wise* campaign and you'll find lots of helpful information about how to do this responsibly.

Poor practice when it comes to getting rid of unwanted aquatic plants – and indeed releasing fish – harms the British countryside and ends up costing us all when the plants take over and need clearing. Ultimately, if the people who buy plants and fish don't act responsibly, then it could bring the whole industry to its knees, in spite of the fact that it is currently unlawful to introduce non-species into the wild.

And one last plea from us - if you love your hobby, another way to support it is to seek out OATA members and buy from them. As a trade association, our members pay a fee to join us and sign up to a Code of Conduct, to give you – as a purchaser – confidence in buying from them. Look out for the sticker on the door or find your nearest retailer by searching on our website at www.ornamentalfish.org. OATA members have put their hand in their pockets to support the industry – and ultimately your ability to enjoy your aquarium or pond. Without our members, OATA couldn't exist to fight hard for your hobby.

**BELOW** Barley straw is used as a traditional and important biological filter, used to prevent algal growth. Plans have, however, been put forward to ban its use.

## Get involved!

Find out more about OATA at www.ornamentalfish.org. The Fishkeeper section on our website is full of useful information for the hobbyist, including a handy link to finding a fish vet. You can also follow us on Twitter, Facebook and LinkedIn by searching OATA Ltd.

# Types of tank

With aquariums being created in an ever-expanding range of designs, what should you consider when choosing a tank for your fish? **Sue Reid** reports.

One of the major difficulties in the early days of the fish keeping hobby was to ensure that tanks were water-tight. With sheets of glass held in place by putty, it was not uncommon for them to spring a leak. Since then, there have been very significant advances in terms of the materials available and the manufacturing processes, which have revolutionised the construction and appearance of aquariums as a consequence.

A basic glass aquarium.

## A traditional glass design

As far as glass aquariums are concerned, it has been the advent of silicone sealant that represents the major step forward. There is no longer any need for a metal framework to support the glass sheets, improving visibility and reducing their weight.

**BELOW** Make sure that your tank is big enough!

AQUARIUM UPDATE

# Stylish fishkeeping with Tetra's new AquaArt Explorer

Tetra's new AquaArt Explorer range adds a stylish twist to conventional aquarium design without compromising on quality, allowing you to make your aquarium a beautiful feature in your home.


This stylish new aquarium offers the quality of a Tetra product and features a contemporary curved glass design, providing a distortion-free panoramic view into the tank. It is available in 30l and 60l capacities so you can choose the most suitable size for your home.

The 60l Tetra AquaArt Explorer Tropical aquarium starter set with 8.5 watt LED light includes the innovative Tetra EasyCrystal FilterBox, with an additional replacement filter cartridge, plus an accurate Tetra HT50 aquarium heater and background poster. Also included is a collection of Tetra's best-selling products such as 100ml each of TetraMin – high quality food for all ornamental fish; Tetra AquaSafe – a water conditioner making tap water safe for fish; and Tetra EasyBalance – a water treatment to reduce the number of water changes required.

The 30l Tetra AquaArt Explorer Goldfish aquarium starter set with low consumption 5 watt LED light also includes the Tetra EasyCrystal Filter, additional replacement filter cartridge, background poster and 100ml each of Tetra Goldfish food and Tetra Goldfish AquaSafe water conditioner.

All Tetra AquaArt Explorer aquariums also feature a transparent cover made of acrylic resin, giving clear visibility from above, with a built-in hatch to make feeding straightforward. It is easy on the environment with low wattage, long-lasting LED lights with COB (chip-on-board) technology. Flexible positioning for the filter and heating equipment and the one-touch Tetra EasyCrystal filter cartridge reduces the need for wet hands, making maintenance straightforward.

The new AquaArt Explorer aquariums will enhance any home – making them perfect gifts for Christmas!

### Further info

Tetra's website is at www.tetra.net

**ABOVE** An aquarium made of glass held together with silicone sealant, the edges of which are protected by plastic.

The glass panels in tanks can now literally be stuck together directly, and the absence of a frame has meant that today, glass tanks can be constructed in a much wide range of shapes, such as triangular corner tanks, than was possible before.

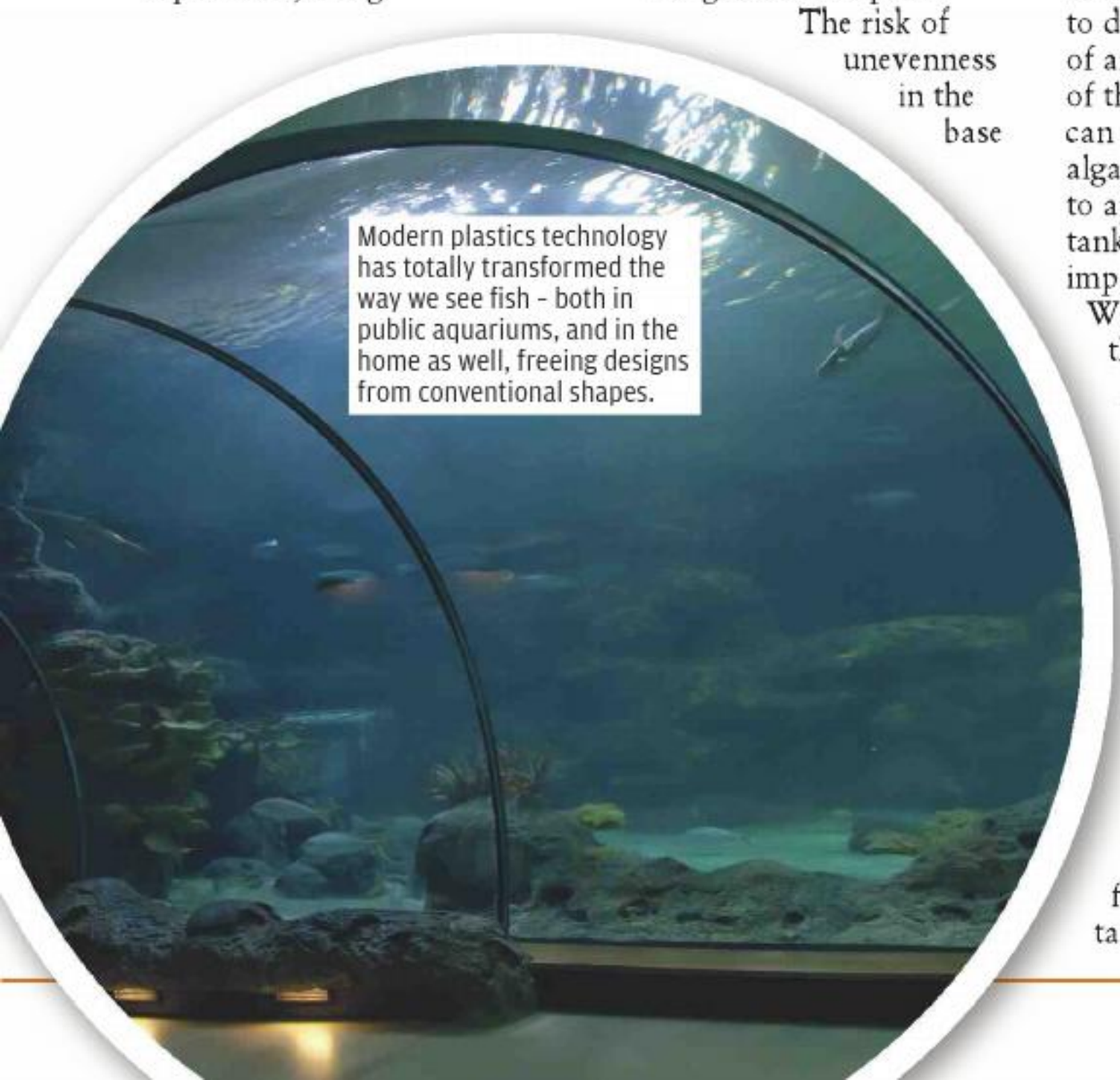
The key thing with silicone sealant is that it forms a very strong and yet not quite a rigid bond. This then allow the aquarium to absorb the force of the water, once it is full, without a risk of splitting apart. Nevertheless, larger aquariums need glass bridges at the top of the unit to reinforce them.

The sealant itself is specially formulated to be safe for use in the construction of aquariums, being free of fungicides and similar potentially harmful chemicals that are found in household products of this type.

## Drawbacks of glass

While glass generally offers excellent viewing of the fish and other aquarium occupants, it is heavy, and particularly so in the case of larger tanks that need to be constructed from thick, reinforced glass. It is not very manoeuvrable either, and easily damaged. You don't even need to drop a glass aquarium to cause problems. Simply upending it, and allowing a corner to take the weight of the unit may be enough to cause serious damage here, by compressing the glass at this point.

The risk of unevenness in the base also means that glass aquariums held together with silicone should not be stood directly an ordinary surface such as on top of a chest, but need to be supported over their entire base with an intervening layer of polystyrene sheeting.



Modern plastics technology has totally transformed the way we see fish – both in public aquariums, and in the home as well, freeing designs from conventional shapes.

## Acrylic tanks

When the earliest acrylic tanks first started to appear on the market, they were quite revolutionary. These were lightweight units, so they could be lifted and carried far more easily than a glass tank of similar dimensions. This in turn meant that they were far less likely to be damaged, although nevertheless, if they were to be dropped, they would often crack, and so they would then have to be discarded.

Although at first, these early acrylic aquariums looked stylish, and afforded good visibility, things changed over time. The plastic tended to take on a yellowish hue, which distracted from the viewing experience. Furthermore, if they started to get greenish algal growth, then cleaning this off with an algal scraper, without actually damaging the acrylic, could be challenging.

Unfortunately, acrylic tanks do remain more susceptible to scratching than glass, although they no longer tend to discolour. The drawback of any damage to the inside of the tank is that this area can be easily colonised by algae, causing green stripes to appear over the face of the tank, where it will be virtually impossible to remove.

When cleaning such tanks therefore, you need to be particular carefully not to damage them at the front.

A background will help to screen any damage at the rear though, so it might be possible to turn the tank round, depending on its shape, if the existing front panel gets accidentally scratched. Even so, you will need to empty much of the water first, in order to move the tank round for this purpose.

## Surface area

When buying tanks of any type, you need to bear in mind that the surface area is important, because it is here that the oxygen will diffuse into the water. Rectangular tanks tend to have a relatively high surface area to volume ratio, compared with taller tanks.

This will ultimately have an impact on the stocking density of the tank. A fairly typical average tank measuring 90cm long x 30cm (36 x12in) wide has a surface area of 2700sq cm (432 sq in). The typical recommended is to allow 1cm of fish (excluding the tail) for each 30 sq cm (equivalent to 1in per 12 sq in). In this case therefore, this aquarium can accommodate fish with a combined head-body length of 90cm (36in).

## Plan ahead

It does not pay to economise when buying a tank. Relatively speaking, they are not that costly, compared with necessary equipment. It is therefore a good idea to obtain a tank that is likely to suit your needs for the foreseeable future with your fish, rather than having to upgrade the tank in due course.

The expenditure under these circumstances does not stop at the tank – you will then need to have a new filtration system, new lights and buy more gravel too. Leaving aside the financial implications though, it is rather like setting up a brand new tank, as you will have to condition the new filter again. This can create unnecessary problems and worry, plus if you have a planted tank, then the plants will have to be moved across as well.

Undoubtedly, it will be better for the fish if they only have to undergo one move at the start. Should you have a community tank, it is obviously important to be able to introduce new fish to an environment where the filtration system is functioning effectively from the outset.

CONTINUES ON THE NEXT PAGE »

## Working out the volume

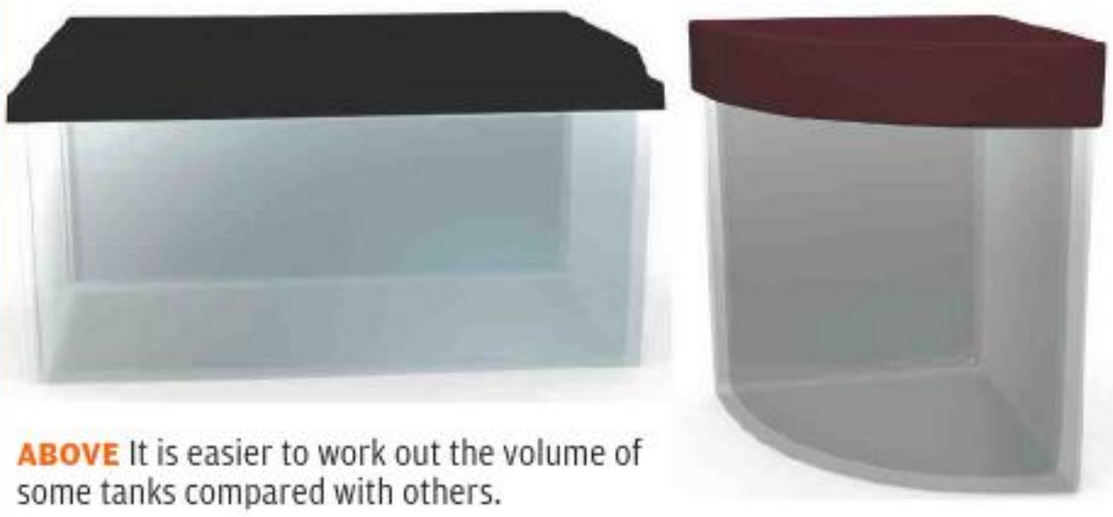
This is the other important figure that you need to be aware of, partly if you need to medicate the tank occupants here at any stage. Although it is easy to work out the volume should you have a square or rectangular tank, keep the manufacturer's figure somewhere safe if you opt for a more unusual aquarium design. Otherwise, unless you strip it down or can find the information online, it will be difficult to gain an insight into the volume.

For square or rectangular units though, multiply the tank's length x width x depth (working in millimetres), then divide by 1000, in order to obtain the total capacity of the tank in litres. Deduct 10% from this figure to take account of rockwork and other tank décor. It is recommended to allow 2l of water per centimetre (roughly 1gal per inch) of fish.

## Cabinets

It can actually save you money if you purchase a complete package from a local aquarist retailer, including not just the tank but everything else that you need, which may include a special stand or display cabinet, depending on where you want to position the aquarium.

Cabinets of this type are available in a wide range to styles, to suit the décor in most homes, ranging from light shades of wood to dark. Furthermore, they are also available as corner units, that can be used in combination with triangular or similar styles of tank that are intended to fit in this part of a room.



**ABOVE** It is easier to work out the volume of some tanks compared with others.

Cabinets can be used to conceal unsightly aquarium equipment, such as external filters.

One of the advantages of having a cabinet, especially with a larger aquarium, is that it can be used to accommodate an external filter that will need to be located outside the tank, and can otherwise prove unsightly. The fish's food and other essential items can also be stored here where they are readily accessible.

**"It does not pay to economise when buying a tank. Relatively speaking, they are not that costly, compared with necessary equipment"**

## The weight of water

The key thing to remember, though, is how heavy water is! A fairly small aquarium, holding just 90l (20gal) will weigh approximately 130kg (285lb) when full. This means that once the tank is in position, you will not be able to move it elsewhere unless you strip it down first, so be certain that it is in the ideal position in the room where it is to be accommodated.

It must not be in front of a window, as sunlight will affect the water temperature within, and this light will trigger algal growth. Then you need to think about where you will be sitting, so you can choose somewhere that gives you a good view.

There are also other considerations, not least the fact the tank will need to be sited conveniently with regard to access to power points for the filtration unit, as well as the lights, not forgetting any heaterstat that may be required.

Keep the tank out of draughts, which means that a hallway next to an outer door may not be ideal, and the fish themselves should be away from music and television systems that are likely to cause them distress.

## Second hand tanks

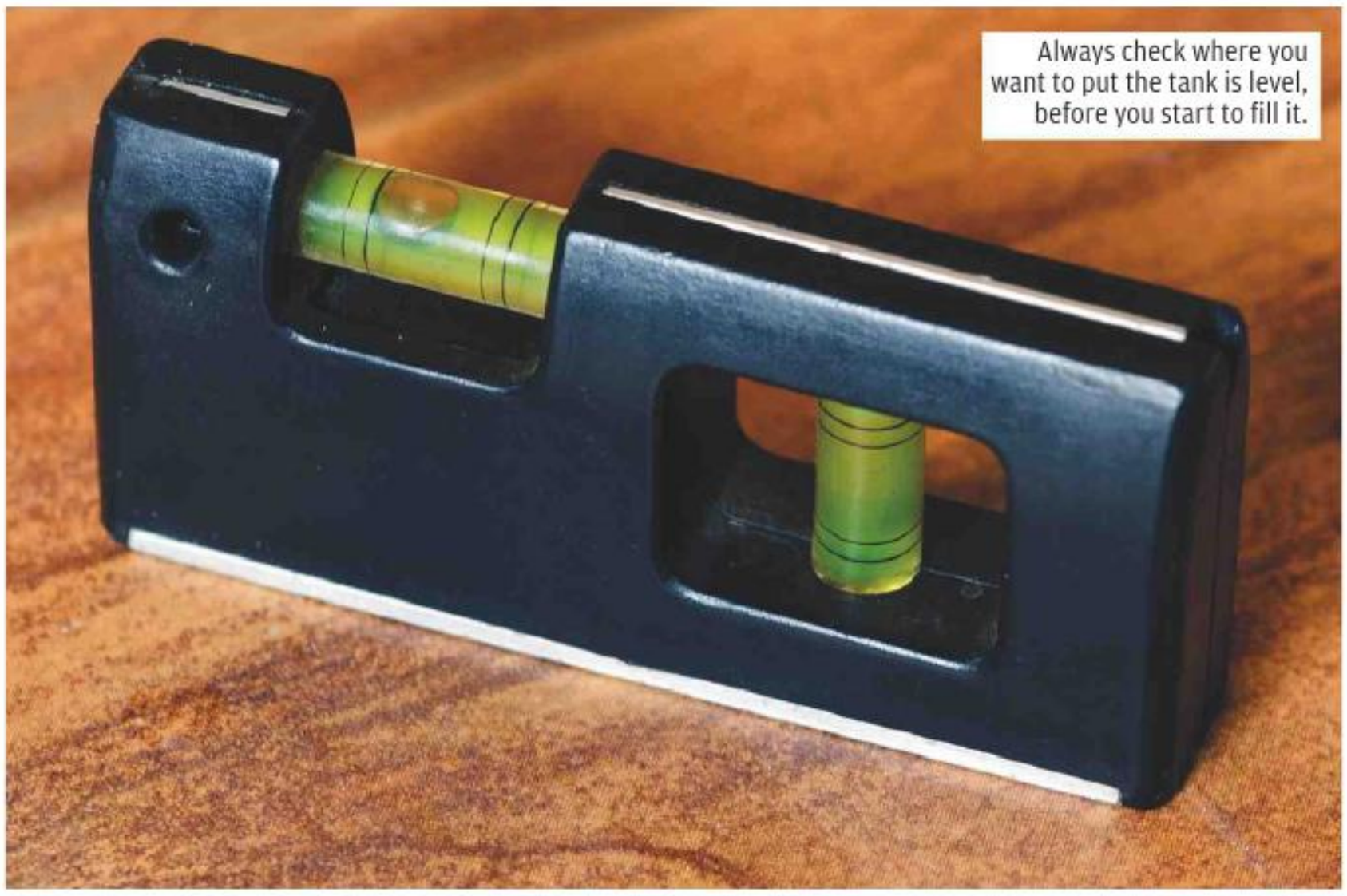
These are often advertised in the free pages of local newspapers and can be a bargain. The problem is that you need to sure that they are watertight, although if the leak is relatively minor, then using aquarium silicone sealant should overcome the problem, if a join between panes of glass is affected.

It is probably not worth contemplating buying a glass tank though, if one of the panes is cracked.

## On the move

When transporting a glass tank – particularly without any protection over its edges – obtain some strips of polystyrene that can be taped around the vulnerable corners and base. Take an old rug or blanket with you as well, to help you lay it down carefully in a car, wedging it in place so that it should not move around here. Always lift the tank from beneath, and do so carefully, particularly if it wet, as it will then be slippery, even if partly wrapped in a rug. Place it on a level surface outdoors if possible, and then wash it out, using a special aquarium disinfectant for this purpose. It is probably a good idea to allow the tank to stand for awhile, just to be sure there are no minor leaks.

Assuming all is well, you can then empty the tank again, before rinsing it out thoroughly so as to remove any trace of the disinfectant. It will then be ready to take indoors, but do not forget to stand the base on a suitable piece of polystyrene, so as to absorb any unevenness in the surface, which would put strain on the joints of this type of tank. It is also always worth ensuring that the stand is level, otherwise you will end up with the water sloping from one part to another. A spirit level can be used to assess the state of the stand, before putting the tank in place. This then allows you to carry out adjustments at floor level if required.



Always check where you want to put the tank is level, before you start to fill it.

# AT A GLANCE

Great fish keeping advice from the Popular Fish KEEPING team


## Find out about the Oscar in just 5 minutes

The oscar (*Astronotus ocellatus*) is also known as the velvet cichlid, because of its very small scales, which give its body an unusual velvety appearance. The eyespot often present near the base of the tail means it is also known as the peacock cichlid. This species first became known to science in 1831, but only became popular as a pet during the 20th century, although it had been valued as a food fish in its South American homeland for centuries beforehand.

### Space requirements

Oscars grow big and mean, with smaller tank mates being simply likely to disappear mysteriously on a dark night. These cichlids can grow to a potentially tank-busting 35cm (14in), so be prepared for this from the outset, if you opt for these large fish which are also big on personality.

A red tiger oscar.

As with many cichlids, the oscar's profile tends to alter with age.

### Care requirements

Obtain a large aquarium, at least 120cm (48in) x 45cm (18in) high and wide for a young pair. A power filter as

### Did you know?

Pairs are devoted parents, cleaning their chosen area of rockwork carefully, with the female then laying up to 3000 eggs here. These should hatch after just 36 hours. Both parents then watch over the young fish at first, which grow rapidly. They can already be 2in (5cm) long at just 3 months of age.

The area most likely to be attacked is the forehead.

well as an undergravel filter will be needed, as oscars are messy fish. They will dig through the aquarium gravel with their jaws, in search of anything edible, and uproot plants at the same time. Aquatic vegetation therefore either needs to float or should be weighed down. Their food should consist of cichlid pellets combined with treats such as the occasional thawed prawn, pea or canned cricket. Young fish prefer special flake food.

## Temperament

Assertive but friendly towards people, these fish will recognise you, and will be waiting for a meal if you feed them at set times every day. Pairs are devoted to each other, forming what can be a lifelong bond while they are still young. Trying to introduce two adult oscars can be tricky though - they may disagree violently. It is always better to obtain a compatible pair, if not young fish.

## Varieties

The oscar's basic 'wild' coloration is greenish-brown with reddish markings, while young oscars have a striped patterning. Selective breeding has created the much more colourful red tiger. Here the red markings are very evident and arranged in an abstract striped pattern, with some individuals being much more colourful than others. You can also choose from albinos, with white bodies and variable orange markings, plus rarer yellowish lutinos, as well as long-finned variants of these colours too.

## Lifespan

Up to 10 years or so.

## Health concerns

Oscars are vulnerable to hole-in-the-head disease, caused by a microscopic parasite called *Hexamita*. Stress (perhaps linked with overcrowding) and possibly vitamin deficiencies may also be contributory factors. The result is likely to be permanent scarring on the face, assuming the fish survives, although successful treatment is possible. Pimples on the forehead are an early sign of this illness, which then enlarge into patches.

# Aquascaping, rearing intelligent fish and the nightmare of guppy breeding

**Victoria Neblik** presents a round-up of the latest news from the world of fish science, as relating to the fish keeping hobby

Developing fish eggs seen under a light microscope

### *"Tankscaping" and Rearing Intelligent Fish:*

One of the most enjoyable things about setting up a new fish tank is surely decorating or "aquascaping" it. Over the past twenty or thirty years, like most other areas of the hobby, this has come on leaps and bounds.

Whether you wish to house your Rift Valley cichlids in an "authentic" miniature African lake, let your piranhas hide among submerged Aztec ruins, or accommodate your Siamese fighting fish with a Chinese pagoda, all the materials for this purpose are readily available.

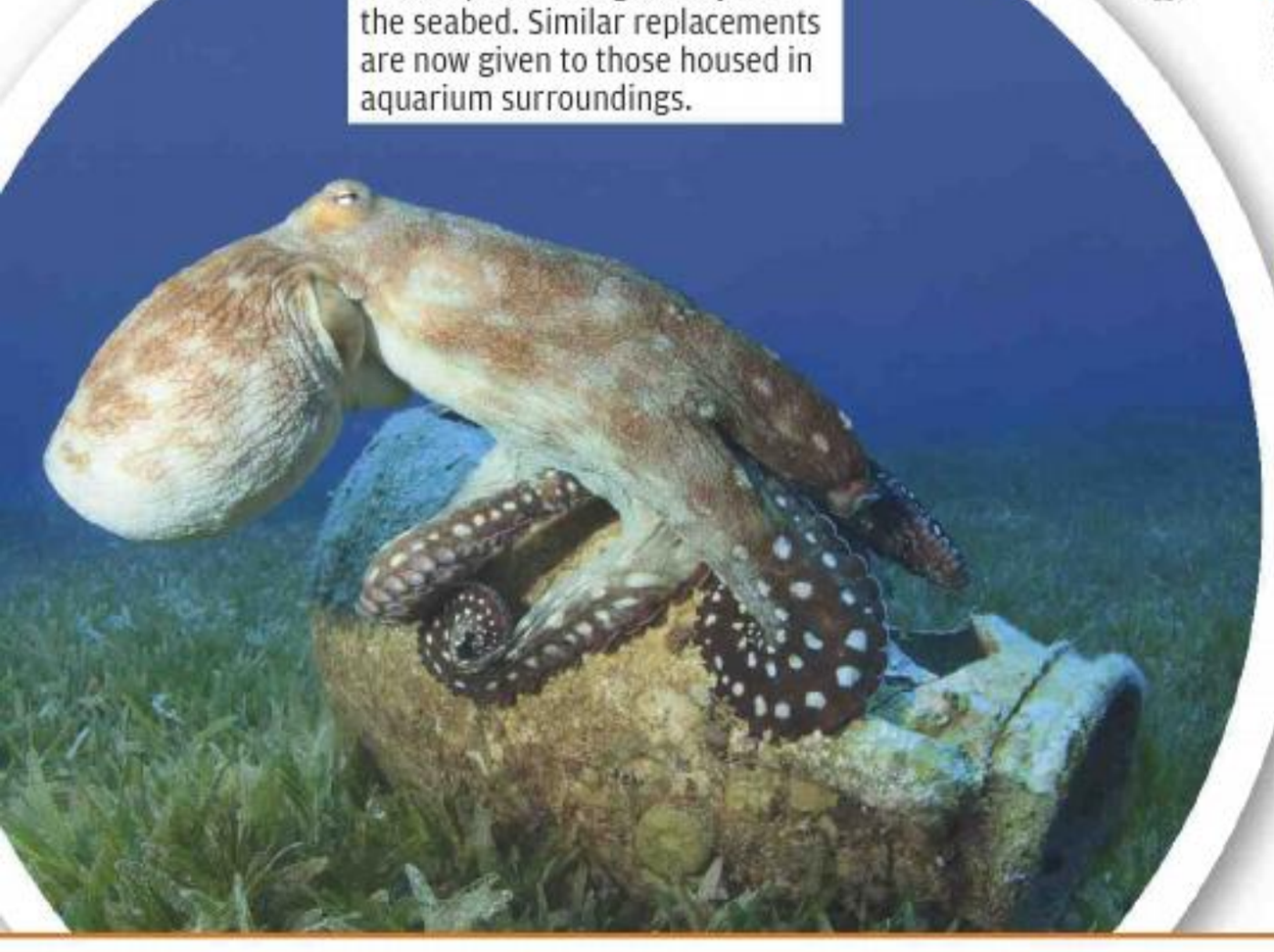
The range of items available almost defies the imagination. Today, even the popular cartoon character Spongebob Square Pants has "his" own range of fish tank accessories, as does Scooby-Doo! While serious aquarists may sneer, there is no doubt that items of this type help to encourage a new, younger generation of fish keepers to become interested in the hobby.

Behind the aesthetics, though, there is an important reason for providing fish with an appealing landscaped environment. Not only does a well-designed tank allow its resident fish to display a range of natural behaviours, but it also creates spaces for the occupants to hide from view at times, reducing their stress levels and therefore making

An octopus investigates a jar on the seabed. Similar replacements are now given to those housed in aquarium surroundings.

**BELOW** Aquarium ornament in the Spongebob Square Pants range, produced by Penn Plax.

**BELOW RIGHT** A haunted mansion aquarium ornament, from the Scooby-Doo range by the same manufacturer.



An enriched environment ensures fish display a wider display of behaviour.

Some Atlantic salmon spend their entire lives in freshwater.

them less vulnerable to illness.

## Environmental enrichment

This idea of creating realistic or, at least, interesting landscapes for animals in collections has long been employed in zoos and public aquariums, where it generally constitutes an important aspect of an "environmental enrichment" programme. These programmes, which seek to reduce stress on the creatures concerned and increase longevity, as well as quality of life, often include various toys and puzzles for more intelligent animals to use and solve.

Historically, this has meant items such as balls suspended on chains for elephants to play with; footballs for herds of calves, and, in the aquatic world, food-filled jars for an octopus to find and open. More recently, scientific research has indicated that environmental and behavioural enrichment programmes can be important for "simpler" and less intelligent creatures than previously realised and zoos now provide programmes even for creatures such as captive spiders.

## Clear benefits

Although the benefits of these schemes are intuitively obvious, there is also real, hard, scientific data supporting their benefits. For example, research dating from the 1990s has shown that, not only do captive-bred animals have a reduced repertoire of behaviours and less flexible behaviour than their wild counterparts. In addition, various regions of their brains are actually smaller and less active than those of their wild-reared relatives. In other words, creatures reared in a simple, monotonous environment can be left permanently mentally restricted, compared with their wild cousins, which typically have to adapt in order to survive.

## Significance for endangered species

This is clearly interesting to anyone who wants to ensure that their own pet animals enjoy the best health – and brain development – possible, but it can actually be critically important when endangered animals are bred in collections in order to be released into the wild, as part of a conservation initiative for example.

As a result of their reduced mental capabilities, some captive-bred animals seem to be less able to cope with predators, for example, than those reared in the wild. In fact, during recent years, scientists have been able to link these behavioural differences to the size of parts of the forebrain in certain

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**"The fish from the enhanced environment seemed to be capable of learning faster and possessed better powers of memory."**

A salmon photographed in the waters of the Drina River in the Balkans, in its native environment that is similar to the conditions within the enriched tank.

animals; they have even discovered some of the genes responsible for creating these differences in brain structure.

## Studies with salmon

This summer, a group of scientists from the University of Bergen in Norway and the US's Penn State University, turned their attention to studying the brains and behaviour of the Atlantic salmon (*Salmo salar*).

Although these fish generally live in saltwater as adults, juveniles of this species are to be found in freshwater streams, sometimes for as long as eight years. In fact, certain populations and subspecies of the Atlantic salmon have no marine phase to their lives at all and, instead, exist entirely in freshwater throughout their lives.

In all cases and regardless of its length, the freshwater "stage" of the Atlantic salmon's lifespan is an important one. For this reason, scientists wanted to investigate the effects of conditions during this freshwater stage of the Atlantic salmon's life on the fish's maze-solving ability, brain anatomy and function. Is early environmental enrichment important for the brain development of these and possibly other fish too, just as it is for animals?

In order to answer this question, a team of the scientists, including Professors Anne Salvanes and Victoria Braithwaite, chose to work on fish being reared in river water at Norway's Voss hatchery. Specifically, they compared the effects that enriched and un-enriched environments had on the "brain power" of groups of juvenile salmon.

**RIGHT** The inclusion of a range of tank décor, such as this treasure chest, should encourage the development of the brans of aquarium fish.

## How the study was set up

One group of fish was therefore given an enhanced tank environment for a period of just eight weeks during the first year of life, whilst the other group were kept in basic surroundings. In this case, "enhancement" consisted of a mixture of pebbles, rocks and floating plastic plant fronds, which were randomly shuffled into a different arrangement within the enriched tank each week. The young salmon in these set-ups were observed to be swimming between the decorations within their tanks and hiding amongst the plastic plants; just as pet fish do in a landscaped tank.

## What was discovered

When the scientists compared the ability of both groups of fish to navigate their way out of a maze individually at the end of the eight week period, they found that those fish which had lived in the enhanced environment were able to perform this task significantly better in overall terms. Although there was little to differentiate the groups initially, the fish from the enhanced environment rapidly became quicker

Wild salmon are more adept at surviving than those reared in sterile environments.

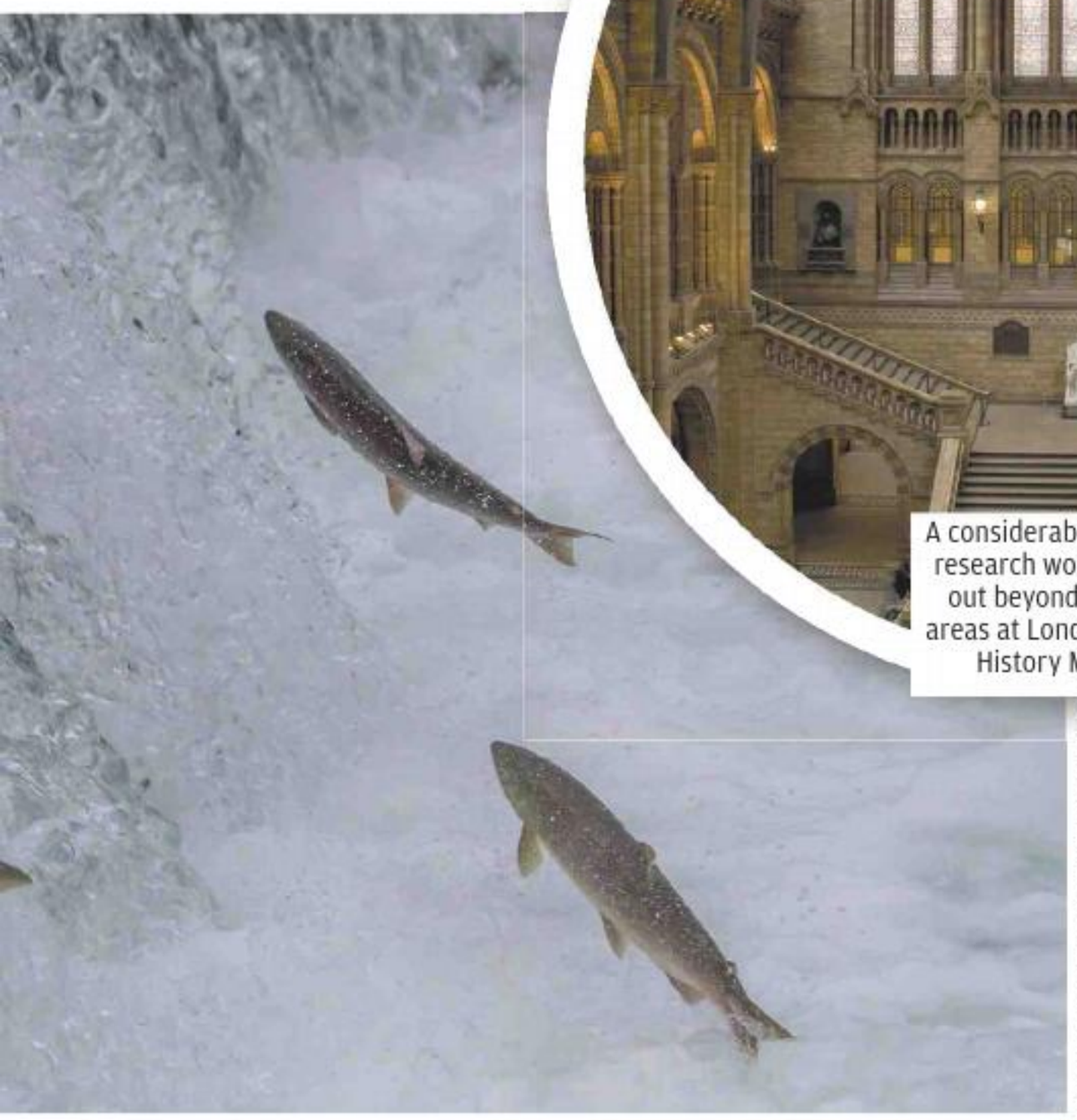
at solving the maze and made fewer mistakes on subsequent days compared with the other fish.

In other words, the fish from the enhanced environment seemed to be capable of learning faster and possessed better powers of memory. This ability to learn rapidly can be immensely useful to young salmon as they try to survive in rivers and then probably the sea, after being released from the safety of the tanks where they are reared as juveniles.

The scientists also found that the evidence of greater activity of a gene associated with formation of new connections in the brain in those fish that had come from the enhanced environment. It is hoped that these results will lead to salmon being reared in tanks that are better-designed, in terms of their furnishings.

## Findings for fish keepers

This in turn should mean that the fish will ultimately be better able to cope with the outside world and survive in greater numbers once they are released. For amateur fish keepers, too, the message is simple: enriched tanks really can help fish brains to develop. So, all those submerged treasure chests and fake rocks do, indeed, provide benefits for pet fish... as well as appealing to their owners.



**LEFT** The gonopodium of the male Guppy is clearly evident here, being the tube-like structure running parallel with the body.

A considerable amount of research work is carried out beyond the public areas at London's Natural History Museum.

## Guppy matings and gonopodia

Some years ago, on a trip to London's Natural History Museum, I was amused to see a venerable and very elderly professor silence the entire staff canteen by pounding the dining table with his fists and proclaiming at the top of his voice that the best, and in fact, the only way to tell the difference between a large number of species was to "look at their genitals".

To the astonishment of the other diners, he then added that this was how he had spent most of his past week. At the time, he seemed, well, perhaps, ever so slightly disturbed. These days, though, I'd have to admit that, disturbed or otherwise, he certainly was not confused, and he undoubtedly did have a valid point.

As ludicrous as it sounds, many animals do, indeed, have genital organs worthy of study. In fact, the biologist Göran Arnqvist once described the diversity of appearance in the case of male genitalia as "one of the most striking and general patterns" in animal evolution. He noted how males of different species typically vary markedly in this regard, even if their general appearance is striking similar.

## The significance for fish

It is tempting to think that this observation is irrelevant to fish because generally, they do not display internal fertilisation, with females simply laying eggs that the males then fertilise. However,

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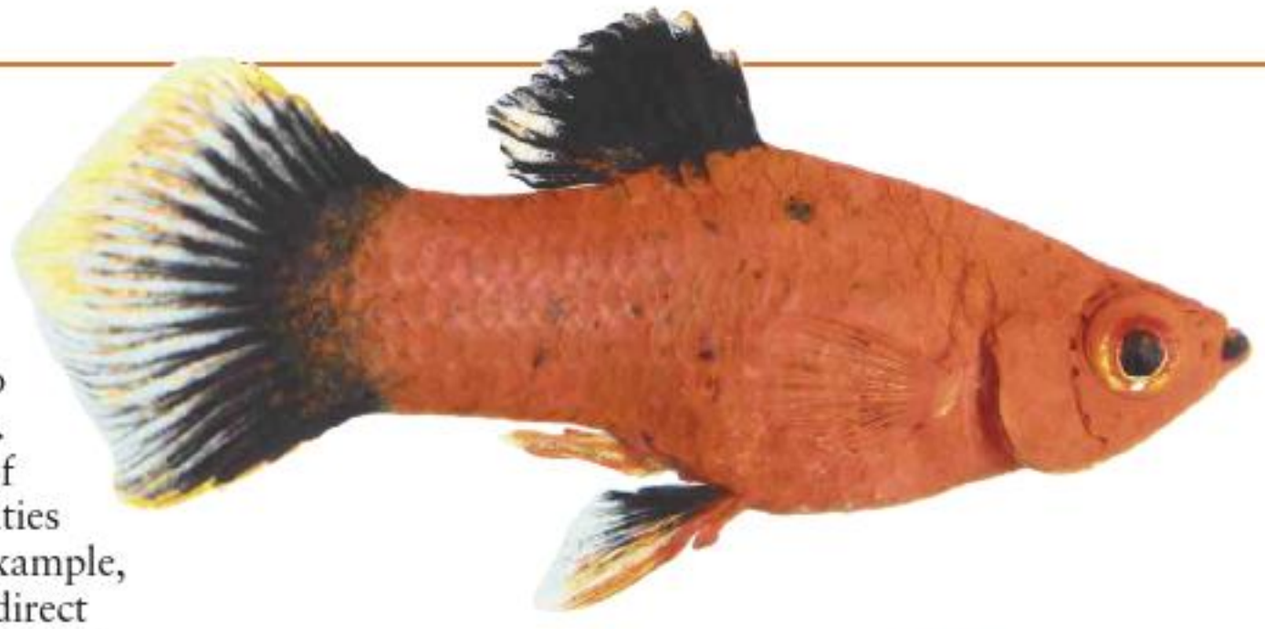
as those who keep livebearers are very aware, not all fish do reproduce externally. Instead, in the case of Guppies, mollies, platies and swordtails for example, mating involves the direct transfer of sperm from the male to the genital pore of the female.

In order to assist with this process, males in such cases have evolved a modified anal fin, known as the gonopodium. Essentially, this is a tube that has evolved from the third, fourth and fifth rays of the anal fin, acting as a funnel to direct sperm into the female's genital pore.



**BELOW** A combination of fin shape, in the form of the gonopodium and a smaller size helps to distinguish male livebearers from females.

**"The unanswered question, though, has been based around why? What does it do?"**

## The puzzling claw

So far, so straightforward. But what is less well known, though, is that in Guppies, this male reproductive organ is adorned with a distinctive "claw" structure near its tip. The presence and shape of this claw has evolved rapidly between different populations of Guppies.

Ordinarily, when a part of anatomy evolves very rapidly or is markedly different in closely related species, biologists assume that, whatever the structure is or does, it must be important. Physical characteristics that are neutral as far as evolution is concerned, being of little significance in determining the survival of the species, tend to evolve and change very slowly, if at all.

A feature that has altered between different populations of the same species is clearly evolving very rapidly. For this reason, biologists have believed for some time that the claw at the end of the Guppy's gonopodium must be important. The unanswered question, though, has been based around why? What does it do?

Now a study by Lucia Kwan and colleagues at the University of Toronto in Canada seems to have solved that question. The scientists came up with the hypothesis that the claw could have three functions.

**ABOVE** Male Guppies need to persuade females to mate with him, because female store sperm in their bodies, and are not reliant on mating every time before they give birth. Some can produce as many as eight broods as the result of a single mating.

## Possible theories

The first was that it might somehow help to sweep sperm from other males away

## Popular Fish Keeping Information point

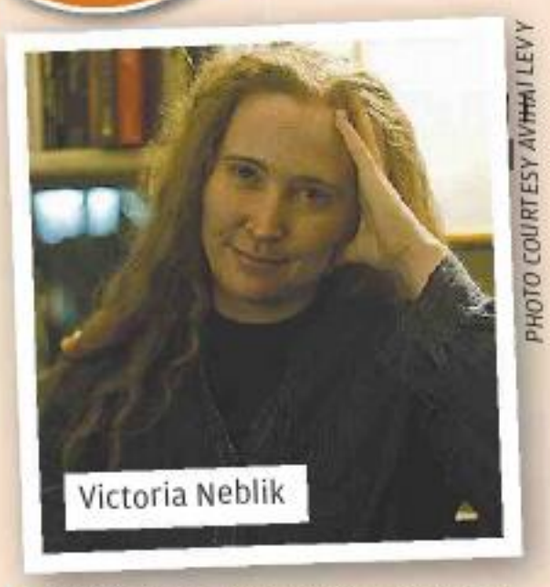


PHOTO COURTESY AVIHAI LEVY

Victoria Neblik

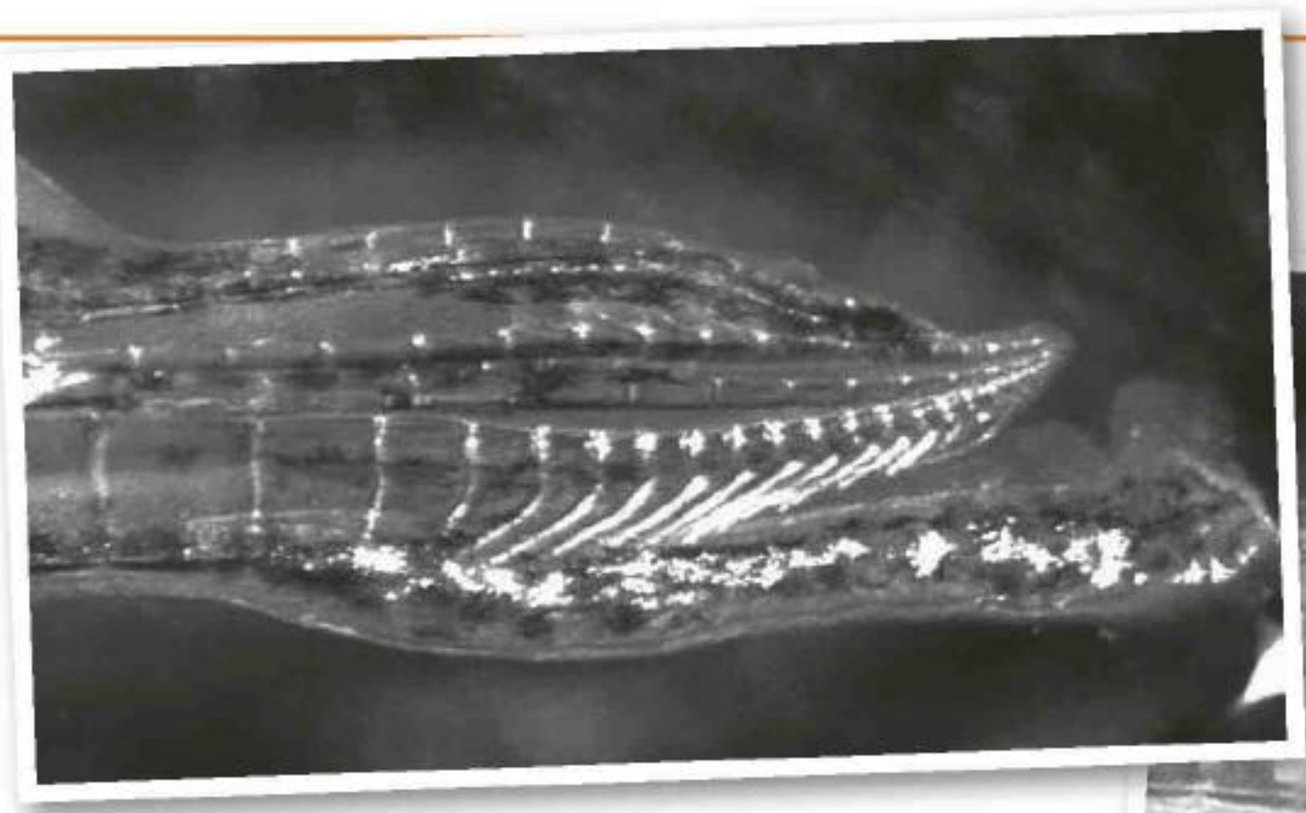
- Dr Victoria Neblik is a writer and former research scientist; her website can be found at www.victorianeblik.com and her books include *Where Flowers Bloom*.

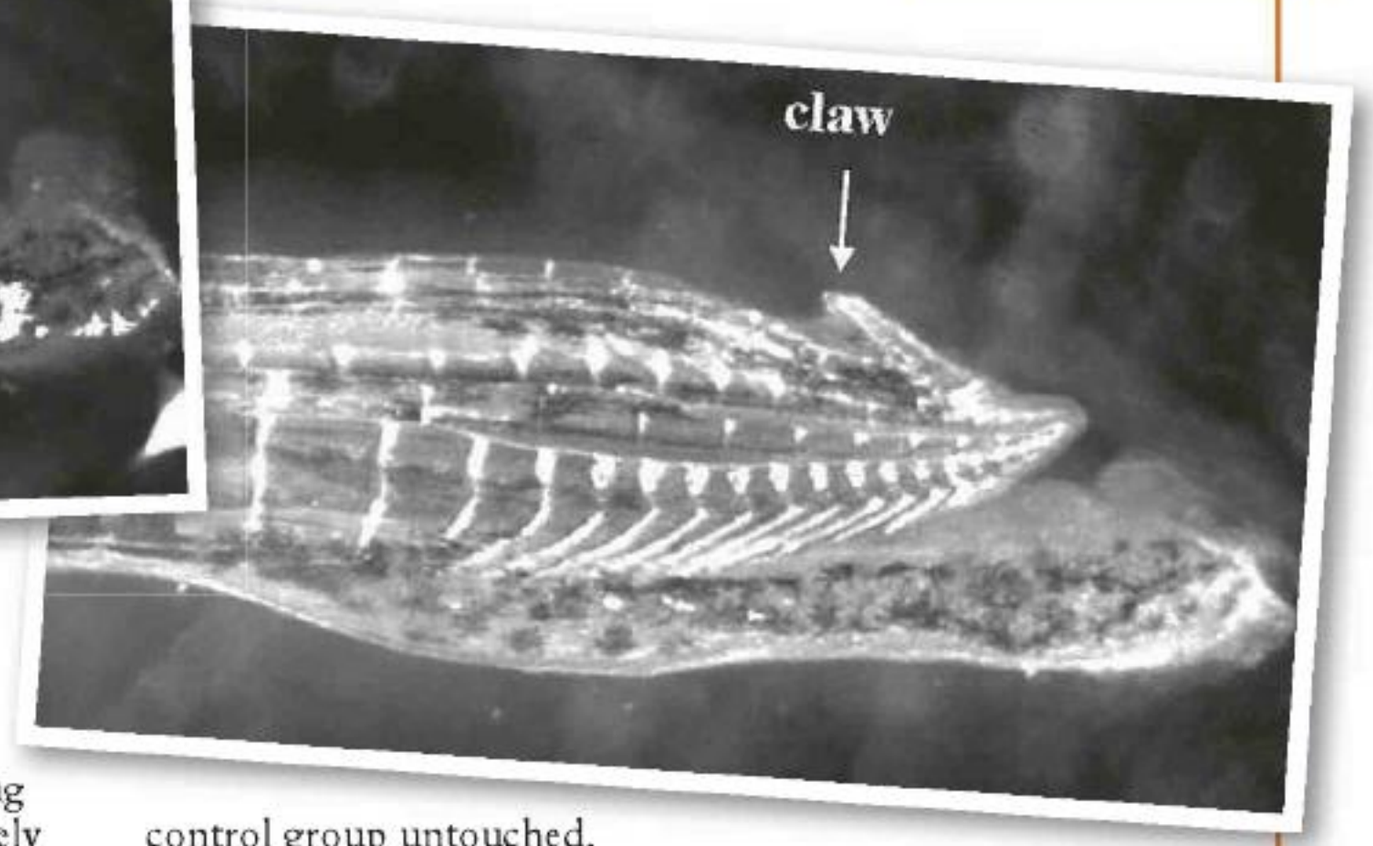
- "Environmental enrichment promotes neural plasticity and cognitive behaviour in fish" by A. G. V. Salvanes, , O. Moberg, L.O.E. Ebbesson, T.O. Nilsen, K. H. Jensen, and V. A. Braithwaite was published by *Proceedings of the Royal Society Series B. 280*, doi: 10.1098/rspb.2013.1331. (2013). The full text can be found online at http://rspb.royalsocietypublishing.org/content/280/1767/20131331.full.pdf

- "The evolution of animal genitalia: distinguishing between hypotheses by single species studies" by Göran Arnqvist was published in 1997 in volume 60 of the *Biological Journal of the Linnean Society* (pages 365–379). His comments were made particularly in the context of insect and arachnid biology, but tend to be more generally applicable. The full-text can be found free online at http://www.zin.ru/Animalia/Coleoptera/pdf/arnqvist_1997.pdf

- "Sexual conflict and the function of genitalic claws in Guppies (Poecilia reticulata)" by Lucia Kwan, Yun Yun Cheng, F. Helen Rodd and Locke Rowe was published in *Biology Letters*, Volume 9, 20130267. It can be found online at http://dx.doi.org/10.1098/rsbl.2013.0267 or http://rsbl.royalsocietypublishing.org/content/9/5/20130267

- "Male harassment drives females to alter habitat use and leads to segregation of the sexes" by Safi K. Darden and Darren P. Croft was published in *Biology Letters*, Volume 4, pages 449-451 in 2008. The full-text can be found online at http://rsbl.royalsocietypublishing.org/content/4/5/449.fullpggvwog






**ABOVE** Minus the claw (above) and with the claw present (right).
*PHOTO COURTESY LUCIA KWAN.*

from the female's genital pore. Males of some animal species do indeed have genital structures that remove the sperm of other males, but in the case of Guppies, this seemed highly unlikely because sperm from previous matings is stored within the female's body and so is therefore a long way from the genital pore. Basically, a male Guppy's gonopodium claw is simply not long enough to reach sperm left by previous males.

This left two other options for the claw - one being that it simply helps to hold sperm in place on the gonopodium immediately before mating. The other suggestion was that the claw allows a male to grab hold of females that are unwilling to mate, thereby effectively allowing males to force the females to mate with them. Both functions were entirely possible, from the anatomical standpoint.

## Practical investigations

Faced with determining the function(s) of the gonopodium claw, the scientists conducted a series of experiments in which they anaesthetised and surgically removed the gonopodium claw from one group of male Guppies. They then compared their mating behaviour and success with that of males that had retained their claw.

In order to make a fairer comparison, the experimenters left the claw in place in the case of this control group but still removed a small, functionless adjacent feature from the gonopodium instead. This was more valid in their view than leaving the control group untouched, because it meant that both the test group and the control group had experienced anaesthetia and surgery.

If the function of the claw was to hold sperm in place, then removing it would always reduce the males' mating success, compared with those that still had claws. If, however, the claw's function was to capture females and coerce them to mate, then removing it would only have an impact on the success of males when females were unwilling to mate with them.

## Close observation required

Fortunately, females that are willing to mate behave differently when males approach them for this purpose, so by watching the behaviour of individual females that had not mated before, when placed in the company of a single clawed or de-clawed male Guppy, the researchers could conclude from the female's behaviour whether or not she had been receptive to the males. All the researchers then had to do was watch the behaviour of the fish and examine the female's genital tract afterwards, to check on the amount of sperm that had been deposited.

They noted that the males behaved in the same manner towards females, whether or not they possessed a gonopodium claw. In cases where the females had been receptive to mating (responding characteristically to the advances of males), so there was no difference in the mating success of males, regardless of whether or not they had a gonopodium claw present.

## The solution is found

Yet when females were unreceptive (as defined by the males having approached the females to mate and then attempted to mate with them, despite being "rebuffed"), those males without the gonopodium claw transferred far less sperm than those possessing a claw of this type. The only explanation for these findings therefore was that the claw holds unwilling females closer or stiller than they would otherwise be, and allows the males to transfer sperm to those females, without their cooperation.

## The impact

Guppies are not alone in this regard, with similar behaviour having been recorded in several other animals, including certain fruit flies. It also tallies with previous studies of these particular fish because, despite their apparently peaceable existence, there is a fierce "battle of the sexes" in Guppies. In fact, it has previously been shown that male Guppies harass females in the wild so much that the females will move to deeper waters to escape from males, even when this puts them at a significantly greater risk of death from predators. The life of a female Guppy, it seems, is far from enviable.

**LEFT** The way in which the larger female Guppy relates to the advances of a male will vary naturally, depending if she is ready to mate or not.

# Fish Doctor

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

## PREVENTING CONFLICT

**Q I set up a tropical freshwater aquarium last year, but recently, I've had problems when it comes to introducing new fish. What is the reason? They seem healthy when I buy them.**

A Firstly, it has to be said that you are always more likely to encounter problems with newly acquired fish. This is because the change in their environment is likely to leave them more vulnerable to illness, particularly if they are then housed immediately with other fish.

Many fish are exposed to bacteria and other microbes in their surroundings that would normally cause them no ill effects, but these can trigger disease under such circumstances. A minor injury resulting from being caught may have damaged the scales for example, allowing a fungal infection to take hold here.

This is why it can actually be very dangerous placing new fish directly into an established aquarium, because not only may the newcomers succumb, but they could infect the other fish here as well. Since diseases spread through the water, so eliminating an infection without stripping down, disinfecting and refilling the whole tank may prove to be very difficult. Adding treatments to the water can help, but these will often destroy beneficial bacteria in the filtration system, and this in turn will worsen the water quality, making the fish more susceptible to disease.

**ABOVE** A catching net is a crucial piece of equipment, but needs to be used carefully to avoid causing injury.

**Q What should I do then?**

A Always transfer your new arrivals to a quarantine tank at first, so you can be sure that they are feeding well and appear to be healthy. This will be relatively inexpensive to set up. Use some water out of the main aquarium and fresh water, treated with a water conditioner for this smaller tank.

If you know that you are likely to be buying some fish in the future, set this tank up so it can cycle properly, allowing the filter to become mature. This will assist the acclimatisation process, and then the new fish can be moved to their permanent home after a couple of weeks.

Even at this stage, introducing the new fish to an existing aquarium where others are already established can still lead to problems, but they should be more robust again by this point. The newcomers are still likely to be viewed as intruders into the territory of the other fish at first, and may be harassed as a result. This applies even in the case of fish that instinctively shoal by nature, so you should watch them accordingly. In some cases, they may never be fully accepted into an existing shoal.

As a general guide, plan both the décor and planting scheme of the aquarium to ensure that fish can have privacy from each other. If one of your fish proves to be a particular bully, then remove this individual for a period, and try reintroducing it at a later stage when harmony may be more likely.

There are also other ways in which you can reduce the risk of newly acquired fish falling ill at the outset. Discarding the water in which the fish were brought home is to be recommended, because there could be a high concentration of potentially harmful microbes here, whereas the new tank will be relatively sterile in this respect.

Floating the bag on the top of the

**"If one of your fish proves to be a particular bully, then remove this individual for a period"**

Watch carefully for any signs of squabbling when introducing new fish to the aquarium.

**LEFT** A case of mouth fungus, arising from infection with *Flexibacter columnaris*. *PHOTO COURTESY PHOTOMAX AT THE GOLDFISH BOWL.*

could become infected, by diving in and taking food that their companion has spat out, exposing them directly to the bacterium too.

water in the new aquarium first is equally important, as this reduces the risk of the fish being unduly stressed because of the changing environmental temperatures. If they become chilled, so their immune system will be less able to resist infections, particularly those of fungal origin that will strike a weakened individual. Some fish foods also contain Vitamin C, and these may be particularly useful at this stage, proving a boost to the fish's immune system when it is vulnerable to infection.

When you offer food to your new fish, watch how they are feeding, as this can provide warnings of possible ill health. Normally, a fish will swallow the food readily, but if you spot that it is repeatedly spitting this out, it is likely to be a sign of so-called 'mouth fungus'. This is a potentially serious ailment that, in spite of its name, is caused by a bacterium. Although any fish can potentially be affected, it is very common in livebearers such as mollies.

An affected individual will need to be separated from the main tank and treated. There is a real risk that other fish

**Q What about stress? Can fish really suffer from this problem?**

**A** Yes, stress can be a major killer of fish, and it is easy to see the signs in some cases. Typically, a fish that is being bullied by its companions will lose its colouration, appearing duller and paler than normal. This is not a permanent change however, but an early warning sign of a problem; transferring the fish to new surroundings where it can settle down in peace should soon see a fairly rapid improvement in its colour again.

Instead of coming forward to feed, a bullied fish will skulk in the background, in the hope of acquiring some scraps. There may be signs of physical attacks too, in terms of torn and injured fins, which are very likely to become infected.

Bullying is most common following the introduction of new fish to the tank, or when individuals come into breeding condition, particularly if the tank is either slightly overcrowded or there are simply not enough retreats in its design. Persistent attacks on a weaker individual at this stage mark the start of a downward spiral that, if unchecked, is likely to lead to its death. Should this particular fish not be allowed to feed properly, then this will cause it to become progressively weaker and more likely to succumb to illness.

**ABOVE** Retreats are important, to reduce the risk of individual fish being harassed and conflict arising.

The choice of fish is significant. Some, such as the red-tailed black shark (*Labeo bicolor*) will live in complete harmony with other fish in a community aquarium but will almost certainly attack others of their kind housed alongside them in such surroundings. Male Siamese fighting fish (*Betta splendens*) are especially notorious - they will fight to the death if kept in the company of other males but are otherwise not generally regarded as aggressive.

During the breeding period, fish often become increasingly territorial, and so it is often better to transfer a pair to a separate breeding set-up once they start showing signs of courtship behaviour and chasing others away. Otherwise, their continued presence in the aquarium is likely to prove disruptive for all the occupants, whether or not they are being directly bullied.

Having spawned, the pair can be returned to the main aquarium, where harmony should be restored. This will also allow you to hatch and rear their offspring in safety, whereas they would be unlikely to survive in the main aquarium, in the company of other fish.

Male bettas must never be housed together - they are also known as Siamese fighting fish because they are likely to fight to the death.

# How to set up a shrimp tank

In our previous two issues, **Lucas Witte-Vermeulen** of Sharnbrook Shrimp explained the needs of these crustaceans, and the initial stages in setting up small-scale 'nano tanks' successfully for them. Here he now provides a guide outlining how to test your tank water parameters in preparation for adding shrimp to your tank, and a step by step acclimatisation process for these crustaceans.

*ALL PHOTOS BY LUCAS WITTE-VERMEULEN OF SHARNBROOK SHRIMP*

## What you will need:

- A metre (3.3ft) or more of airline. (Some sellers add this in the box with your first purchase).
- A plastic tub, yogurt or ice cream pot or anything else suitable.
- An airline clamp (a knot in the airline will suffice if you don't have a clamp).
- A suction cup to attach the airline inside the tank (although wedging it between the tank lid may also work).
- Patience.

Crystal red bee shrimp are popular.

Your tank should have been cycling for the past month, and bacteria will have slowly colonised your filter and are now starting to turn any toxic ammonia ($NH_3$) into toxic nitrite ($NO_2$) which will later be converted to less harmful nitrate ($NO_3$). Once the beneficial bacteria responsible for these conversions are well established in your tank, it will allow rapid breakdown of the waste produced by your shrimp.

CONTINUES ON THE NEXT PAGE »

# Popular Fish KEEPING Expert guide... how to set up your shrimp tank

Now follow these instructions carefully so you can acclimatise your shrimp properly:


Equipment for shrimp acclimatisation.

**1** Your shrimp should arrive double bagged, so remove the outer bag carefully, placing the inner bag containing the shrimp into the container. Cut the bag open at top, and one side from top to bottom so that the water flows out without having to tip the bag – this is important so that shrimp do not get squashed in the collapsing bag or get stuck in the folds as the water rushes out. Also be careful with the scissors, so as not to harm the shrimp.


2

**2** You should now have a container filled with water from the bag and your new shrimp. Carefully pour out most of the water, leaving a couple of centimetres (0.75in), which should be enough for the shrimp to swim in. Put this container below your main tank.


3

**3** Place the airline with one end a little below the water surface of your tank, using a suction cup or wedge it in your tank lid to stop it popping out of the water, and place the other end just over your container with the new shrimp. Then add the clamp on the airline just above the container to regulate the flow.


4

**4** I now suck on the end until the water starts to come through and quickly place the end over the container, but it will be safer to start the flow with a syringe, rather than running the risk of getting tank water into your mouth. Tighten the clamp or the knot until the water drips at about one drop per second into the container.

**5** When the container is full, remove half the water and start again with a slightly faster drip. Repeat, each time halving the water and filling it up again. This should take about 2-3 hours. If at any time the shrimp start swimming about rapidly, pause the process for about 30 minutes until they settle, then carry on. You want to end up with the majority of the water being from your tank and the shrimps are looking lively and happy (but not frantic). Seeing the shrimps searching for food is a good sign that everything is going well.


5


6

**6** Now if you really are careful, you can get a second container filled just with your own tank water, net out the acclimatised shrimp and pop them into this new container, then net them straight out again and into your main tank. (This is just an extra biological precaution if you don't have a quarantine tank).

***Ready to go***

Catch the shrimp carefully, and take care to ensure that they cannot jump out as you transfer them to their permanent quarters. The shrimp should start looking for food straightaway here, as they will not have fed for a while during transit, but do not be tempted to overfeed them, as this will harm the water quality.

Both ammonia and nitrite are highly toxic to invertebrates, while nitrate is less so, but its level should still ideally be zero or as close to zero as possible. Ammonia, nitrite and nitrate are the three main chemicals that you need to be testing for.

## Testing the water

There are many testing kits available and all pretty much do the same thing; however, some are more accurate than others! Drop tests are very popular and quite accurate; however, you can use a more simple paper test and see all the results you need at the same time.

**RIGHT** Water test canister with a chart so you can interpret the readings.

Using the test method of your choice and carefully following the manufacturer's instructions, test the water in your tank. Ammonia and nitrite levels should be zero, and nitrate should be as close to zero as possible and never over 5mg/l.

If you find your water shows any ammonia or nitrite, add more of the beneficial bacterial culture and wait a few more days before testing again. If you find your water has a concentration of more than 5mg/l for nitrate, you will need to carry out a 10-20% water change, add more bacteria and wait a further day or two before testing again. This is summarised in the chart at the bottom of the page.

## Don't be impatient!

Remember this might all sound like a long drawn out process, but it is essential for the survival of your shrimp. If you are still getting high nitrate readings, try testing your tap water, as you might find it already contains a high level of nitrate. Should you need them, there are many products that lower nitrates; however, a naturally matured tank that has completed the nitrogen cycle will hold you in better stead in the long run. Switching to reverse osmosis (RO) water is an option if you have particularly high levels of nitrate in your tap water. We shall look at reverse osmosis again when we discuss hard water, pH and total dissolved solids which are all important when keeping more sensitive varieties of shrimp, rather than the relatively hardy cherry shrimp.

## Adding the shrimp to your tank - acclimatisation

Remember, more often than not, the shrimp you purchase - either online or at your local fish shop - will be kept in water with different parameters to yours. However, this is not a problem as long as you make sure they get used to the new water slowly.

Prepare to add a small

### Water parametres chart

| | Ammonia ($NH_3$) | Nitrite ($NO_2$) | Nitrate ($NO_3$) |
|---|---|---|---|
| **Perfect and ready to add your shrimp** | 0 | 0 | 0 to 5mg/ml |
| **Add more bacteria** | | | |
| **Wait a few days before retesting** | present | present | present |
| **Carry out a 10-20% water change and more bacteria.** | | | |
| **Wait a few days before retesting** | 0 | 0 | >5mg/ml |

Plants will help to absorb nitrates.

Indian almond leaf can aid water quality.

## Top Set-up Tip

In the unlikely event that you spot a dead shrimp in the bag, take a photo before you cut the bag open, which shows that it is still sealed. All responsible sellers will offer a guarantee of live arrival and will credit you accordingly. However, most will require some sort of evidence of a shrimp arriving dead, and it is easily provided in this way.

number of shrimp at first, so as not to overload the system. As a rule, add no more than one shrimp per litre (0.2gal) of water. Once you are more experienced or if you have invested in a larger tank with a large canister filter, you can increase the stocking level.

### Maintenance and care of your shrimp tank:

Shrimp require a lot less maintenance and are actually easier to look after than fish, especially once they are established in their quarters. This is primarily because they eat less and so create far less waste. As long as they are in a mature tank with good water quality, they do not require much work, aside from feeding and the occasional water change. Remember plants and mosses are essential to the ecosystem in your tank as they absorb nitrates and add oxygen to the water column. Lots of live plants are key to a healthy set-up, with plastic plants not being recommended for a shrimp tank as they serve no purpose.

Remember when using solid food, only offer as much as the shrimp can consume in a few hours and with powdered food, follow the instructions on the container carefully. It is always better to underfeed the shrimp than to overfeed, endangering the water quality in the process.

It is recommended to add an Indian almond leaf to your tank (or perhaps more than one, depending on size of the tank and leaf). This will slowly release tannins into the water. These will be beneficial to the shrimp, being anti-bacterial in nature. In their natural environment, there are always rotting leaves and other detritus in the water that become covered in a bio film, providing the shrimp with a source of food. They will also consume the actual leaf, so leave it in the tank until it virtually disappears as it is eaten up.

When you go away on holiday, the almond leaf will serve as a source of food for at least a week or two until you return, but topping the water up may still be necessary as the result of evaporation. There are many other maintenance tips and other beneficial additives which will be discussed in future articles when we look at more advanced shrimp keeping and breeding, but for now, enjoy your foray into your new shrimp keeping hobby, with everything set up and the shrimp established in their new home.

Crystal red bees feeding on Mosura Speciality Food.

### Next time

Lucas explains the different types of shrimp that are available, and provides a guide to their specific needs.

### Contact point

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**LEFT** Mosura products used in this feature.

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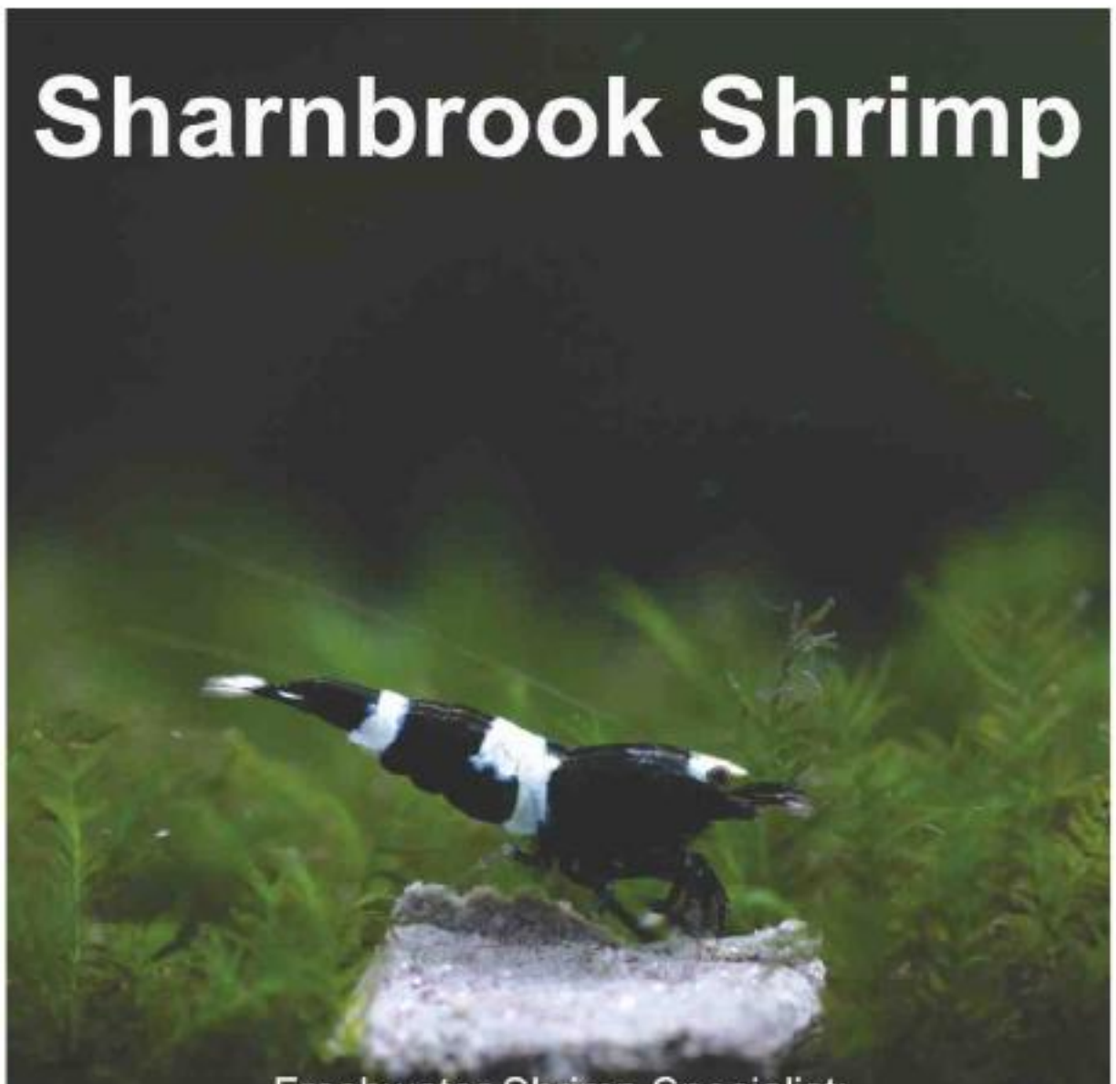

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Female Guppies – their size impacts on the number of offspring that they will produce. A German yellow tuxedo variety is shown here.

# 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?**

## Unexpected birth

**Q We have a female Guppy in our aquarium who appears to have given birth to young, but we don't have a male in the tank. Is it possible that she mated with one of the tetras? We've had her six months.**

A No, you won't be looking at hybrid offspring! Female guppies only need to mate once, and they can then produce as many as eight broods in succession, as they are able to store sperm for this purpose. What has happened is that your fish must have mated previously, before you acquired her, and this is why you now have young Guppies.

It will probably be advisable to rear them separately in a small tank until they are larger, unless the existing aquarium is very well planted, as they are otherwise likely to fall victim to other tank occupants. Bear in mind that you may also find more unexpected broods in the future, but if you look closely, you will see that the female has started to swell in size beforehand, giving you a clue that she will soon be producing more offspring.

## Winter care for goldfish

**Q We built a pond this year, and stocked it with various goldfish, including shubunkins and moors. Will they now be able to stay outside through the winter?**

A Goldfish can be broadly divided into two groups, based on their body profile. There are those such as shubunkins and comets that are similar to ordinary goldfish in appearance, being relatively slender and streamlined.

The so-called 'fancy breeds', however, like the moor and lionhead, have a shortened and much more rounded body shape. This affects the way that they move, with fancy goldfish being less powerful swimmers than ordinary goldfish.

The ancestors of all these fish are a type of carp that is found in the waterways of southern China, and in theory, they are all quite hardy, particularly if they have been acclimatised as yours have been over the summer period, living outdoors in a pond. However, in the case of fancy varieties, the change in body shape has also affected a vital internal part of their anatomy.

The swim bladder, which is an air-filled sac used by the goldfish to provide them with buoyancy, is compressed because of their more compact body shape. This means that fancy goldfish tend to have more difficulty in maintaining their position in the water.

Changes in water temperature, and particularly cold water, are likely to trigger cases of swim bladder problems. These result in the fish listing at an unusual angle in the water, being unable to maintain its balance. As the fish's metabolism slows and its appetite declines, so it will become more vulnerable to this problem. You will therefore need to bring your Moors and any similar goldfish indoors for the duration of the winter.

**"Goldfish can be broadly divided into two groups, based on their body profile"**

Shubunkins are hardy goldfish.

A pearlscale showing the distinctive rounded body shape that characterises less hardy varieties of goldfish.

Try not to stress them during this process though, as this too can be harmful. Check the current temperature of the water in your pond, and then take care to ensure that the water in the aquarium will be at a similar temperature before you transfer the fish here. Don't forget to use a water conditioner as well. The temperature will rise gradually in due course, allowing the goldfish to adapt again to the warmer conditions.

It is not just body shape that is important though, in determining the relative hardiness of goldfish. Those with long, trailing fins, such as veiltails are likely to be more vulnerable to damage to this part of their body, as the water temperature falls.

This is because under these conditions, the fish's immune system will not work as effectively. The fins are likely to end up looking ragged, and can be attacked by opportunistic fungal infections, particularly as the temperature falls further in the depths of winter, so if you have fish of this type outdoors at present, it may be better to bring them indoors too.

## Sponge talk

**Q I notice a lot of muck builds up on the sponge in my power filter. Is this where the bacteria are located? I always worry that when I replace a sponge, then I lose a lot of these beneficial bacteria.**

A Yes, the fine pore structure of these sponges can be home to a significant bacterial population that helps to break down the waste matter drawn into the filter. Yet if you have a more complex filter, with ceramic media present, these are devised specially to offer a large surface area for these bacteria.

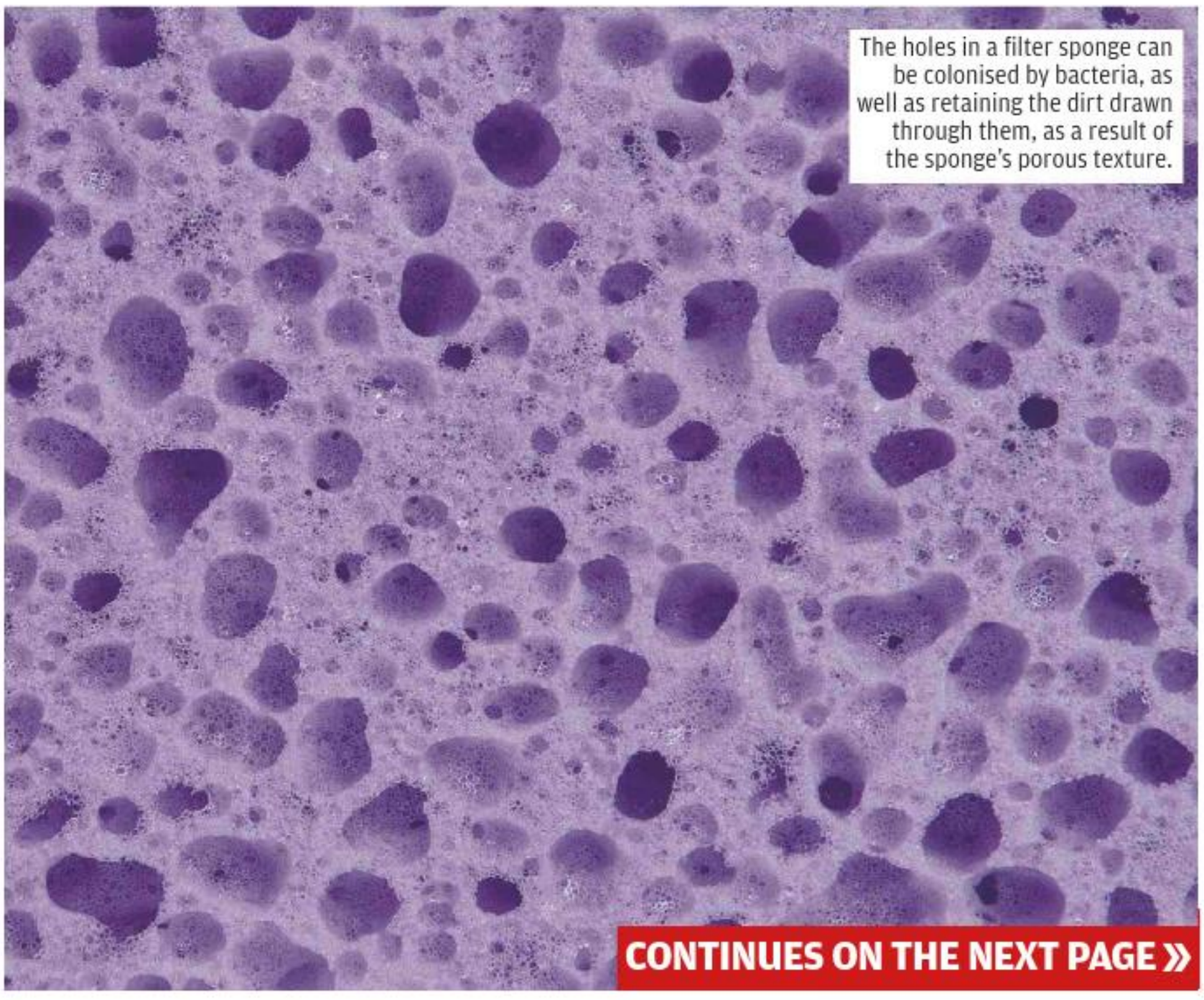
Under these circumstances, the sponge in the filter serves to provide mainly mechanical filtration, rather than biological filtration. Basically, it acts like a sieve, drawing particles out of the water that are passing through the filter, and retaining them. This is why the sponge in the filter ends up being so mucky.

Yet there should be no need to keep throwing these away on a regular basis, as it is possible to clean them, as part of your regular tank maintenance. Get a pair of gloves and a bucket, filling this with some of the water that you have siphoned out of the tank when carrying out a partial water change.

Simply put the filter sponge in this bucket of water, and then squeeze it and wring it out repeatedly. This then flushes out most of the dirt, but will leave the bacterial population essentially unaffected, as you have used tank water for this purpose, rather than tap water containing chlorine that would be harmful.

This treatment should actually improve the effectiveness of the biological filtration too, because more water will flow through the sponge again, conveying the vital oxygen that these beneficial bacteria require, to break down ammonia.

When you replace an old sponge with a new one, just keep a check on the water quality, to ensure there is no temporary dip, taking particular care not to overfeed the fish at this stage as this will otherwise place unwanted stress on the filtration system. If there is a problem, then a partial water change will help under these circumstances.



The holes in a filter sponge can be colonised by bacteria, as well as retaining the dirt drawn through them, as a result of the sponge's porous texture.

CONTINUES ON THE NEXT PAGE »

## Algal-eaters

**Q Can you give me some advice about keeping flying foxes please?**

A The reason for the unusual name of these fish is slightly mysterious, although their slim-line body shape indicates that they are fast swimmers. Originating from parts of south-east Asia, they can grow up to 14cm (5.5in), and they are suitable for a community tank, living happily in the company of other fish. Nevertheless, only keep one per tank, because they are likely to be aggressive towards each other in these surroundings.

The good news is that flying foxes are not especially fussy either about water temperature or water chemistry, being happy in a typical tropical community set-up. They tend to be mainly vegetarian in their feeding habits, and will eat prepared foods of this type.

A real advantage of having a flying fox in a aquarium is that this fish will browse contentedly on algae, helping to keep the glass and décor free from this microscopic plant growth.

Adjusting the lighting and including other plants that will compete with the algae for the nitrate in the tank water that aids their growth should help to curb this problem. But the flying fox is very well equipped to tackle the issue head-on, thanks to its specially equipped jaws. There is a rasp on its upper lip that allows it to scrape off algae without difficulty.


A flying fox (*Epaizeorhynchos kalopterus*). These fish thrive in well-planted tanks.

## Koi possibilities

**Q Our local garden centre has significantly reduced the price of its koi. Do you think it is safe to buy them now?**

A It rather depends on the condition of the fish, and how they are housed, not to mention their size too – if they are indoors, then it is not a good idea to transfer them straight to a pond at this time of year. But if they are reasonably small, and you have a suitable-sized aquarium available with a filter, then you can house them here over the winter.

Koi can be kept in these surroundings, although you need a powerful filter as well, to cope with their waste, and be prepared to carry out frequent partial water changes too. The advantage of housing them in this way now is that the fish will continue eating and should grow well over the winter period, so they will be in top condition when it is suitable to transfer them outdoors to your pond next spring. They will then not need to be brought in again.

Young koi can be kept in a large aquarium.

## Goldfish of different size

**Q Does it matter if I have goldfish of quite different sizes in my tank? My friend is emigrating, and wants me to take hers as well, which is much smaller than mine.**

A This should not be a problem, and having been kept on its own for nearly a year now, your friend's goldfish should not pose any significant health threat to your goldfish either. Do be sure that your aquarium is big enough though, to accommodate both fish adequately, and check the filter will be suitable too, bearing in mind that your friend's goldfish may undergo a growth spurt in its new surroundings.

Goldfish are not normally aggressive by nature, and although they do not live in shoals as such, they will often associate together, so there should be no difficulty in putting them together. Although it is often said that goldfish grow in proportion to the size of their surroundings, this is not entirely true. Some strains of these fish naturally seem to reach a larger size than others, so provided that the newcomer is eating well, do not worry if it does not become as large as your present goldfish.

Goldfish of various sizes can be kept together.

**LEFT** A common hatchetfish (*Gasteropelecus sternicla*).

## How about hatchets?

**Q Are hatchetfish easy to keep?**

A What makes these fish unmistakeable is their highly distinctive appearance. They have a relatively straight back, combined with what appear to be very swollen, almost semi-circular underparts. There are several different species that are quite commonly available, with the spotted hatchetfish, growing to a length of 9cm (3.5in), being the largest.

The hatchetfish's flat back enables it to lurk close to the surface of the water, leaping upwards to seize insects in the air above. If threatened by a potential predator, these fish can also leap up out of the water, with their very narrow profile helping them in this respect.

Should they become frightened in aquarium surroundings, they may react in a similar way, and it is very important that they are only kept in a covered aquarium, so there will no risk of them ending up on the floor.

You should include floating plants in an aquarium housing these fish, in order to give them a sense of security. Water lettuce is ideal for this purpose, because its trailing roots, hanging down into the water, will also provide these fish with somewhere that they can hide. The more subdued lighting effect here will also highlight their patterning, although none of the species is brightly coloured.

As might be expected, hatchetfish will feed at the surface of the aquarium, and can be given foods that float, with items such as freeze-dried tubifex worms and similar items being popular. They will also take fruit flies very readily. These can be purchased from livefood suppliers advertising on eBay and similar sites.

Hatchetfish can't be sexed visually, but if you keep a small group, then hopefully, you will have at last one pair amongst them. The male attracts his intended mate by fluttering around her, displaying with his fins.

Spawning takes place amongst the roots of plants, with the eggs sticking here, or falling down further into the aquarium. Hatching occurs about a day later, but the young then remain largely inert in their surroundings, for up to five days. During this time, they absorb the nutrients present in the yolk sac, before becoming free-swimming. A fry food should then be provided for rearing purposes.

At first, the young hatchetfish will utilise the entire aquarium for swimming purposes. Only from the age of about three weeks onwards do they then start to gain the distinctive body shape of adults, and begin to remain in the upper reaches of the aquarium. Their lifespan is likely to average around three years.

# FISH FOCUS

Tetra

**"As its name suggests, its homeland is in Colombia, north-western South America, where it is found in the Río Acandí region"**

## Colombian tetra
## *Hyphessobrycon colombianus*

This attractive tetra is a relative newcomer on the aquarium scene, having only been discovered as recently as 1995. As its name suggests, its homeland is in Colombia, north-western South America, where it is found in the Río Acandí region, close to the border with Panama.

It is slightly larger in size that many other tetras, and although suitable for a community aquarium, it is better to house this species alongside fish of similar size. Colombian tetras should be kept in a group comprised of several individuals, and must not be housed with companions that have long, trailing fins, as they may nip at these, causing injury.

The colouration of Colombian tetras is quite subtle, and if these fish are housed in bright surroundings, they can end up looking rather washed-out in appearance. What you need to do is to provide plenty of cover, using bogwood and floating plants, ensuring the tank lighting is relatively subdued, so as to emphasise their natural colouration. They tend to swim in the upper part of the aquarium, and can jump, so beware! Colombian tetras are very easy to cater for, in terms of their feeding needs. They will take flake food, as well as suitable freeze-dried items and livefood too. A varied diet, including items such as bloodworm, will help to maintain their colouration. Sexing is possible, with males being more brightly coloured, and having a slimmer body with a more pronounced dorsal fin. These tetras are egg-scatters, with a female producing as many as 2000 eggs at a time, which are fertilised by the male as they are laid. Hatching normally takes a day or so, and the fry will start to swim freely once they have absorbed their yolk sacs soon afterwards.

### Key info:

**Grows to:**
6.5cm (2.5in)

**Water chemistry:**
soft and acid-neutral

**Water temp:**
24-26°C (75-79°F)

All these products can be useful for keeping Colombian tetras.

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# Always expect the unexpected!

Having worked for many years as the curator of a zoological collection, Bill Lowe soon became accustomed to the fact that the public was particularly fascinated by some of the more predatory fish in the collection. More often than not though, he found himself having to explain away some of the widespread misconceptions about the bloodthirsty habits of those that have long enjoyed a bad reputation for being "man-eaters".

"They eat people, don't they?" was a question I grew accustomed to answering time and time again during my 19 years being in charge of a zoo in Scotland. Needless to say, this question was usually fired at me by members of the public passing the tank containing the piranhas, which were housed within the small aquarium section.

A pacu *(Colossoma macropomum)* – these fish are close relatives of the piranha.

## Feared killers!

Piranhas are natives of South America and are members of the Serrasalminae sub-family of characins. No-one is certain as to how many species exist. Estimates vary from less than 30 to over 60. They have a close cousin in the pacus, which also hail from South America. These two groups of fish are similar both in terms of appearance and behaviour, although the latter are

Piranhas do possess a formidable set of teeth.
Photo courtesy Andrewself.

essentially vegetarian, thriving on a diet largely comprised of fruit.

Mature piranhas can grow to become extremely large, although they are unlikely to develop to any great size when kept in an aquarium. The smaller species of piranha normally average no more than 10cm (4in) in overall length, although individuals can sometimes measure up to 30cm (12in). The larger species tend to enjoy greater longevity. Generally, their lifespan varies from anything between four and 15 years.

Piranhas clearly don't enjoy a particularly good press, although, in my opinion, their bad reputation is often undeserved. This is something that I would try to explain to visitors to the aquarium – but I have to admit that I was usually fighting a losing battle on their behalf.

Their aggression, in terms of launching an attack on any unwary person or creature who ventures into their riverine domain, flaying the flesh from the bones of both people and animals, has been fostered to good effect for many decades by the directors of horror films, seeking to thrill film-goers with a good helping of blood and gore.

In fact, piranhas are extremely unlikely to attack any large creature or, indeed, any human, unless they feel particularly threatened, they are trapped, or they are quite literally starving. Most attacks occur during the breeding season. In the wild, piranhas appear to have favourite breeding locations and anyone paddling around and disturbing their watery environment is likely to be bitten, being perceived as a threat to the young.

CONTINUES ON THE NEXT PAGE »

The waterways of South America are home to piranhas.

**ABOVE** The red-bellied piranha *(Serrasalmus nattereri)* is one of the most colourful and widely-kept members of the group, although its colouration tends to fade as it gets older.

## Aquarium care

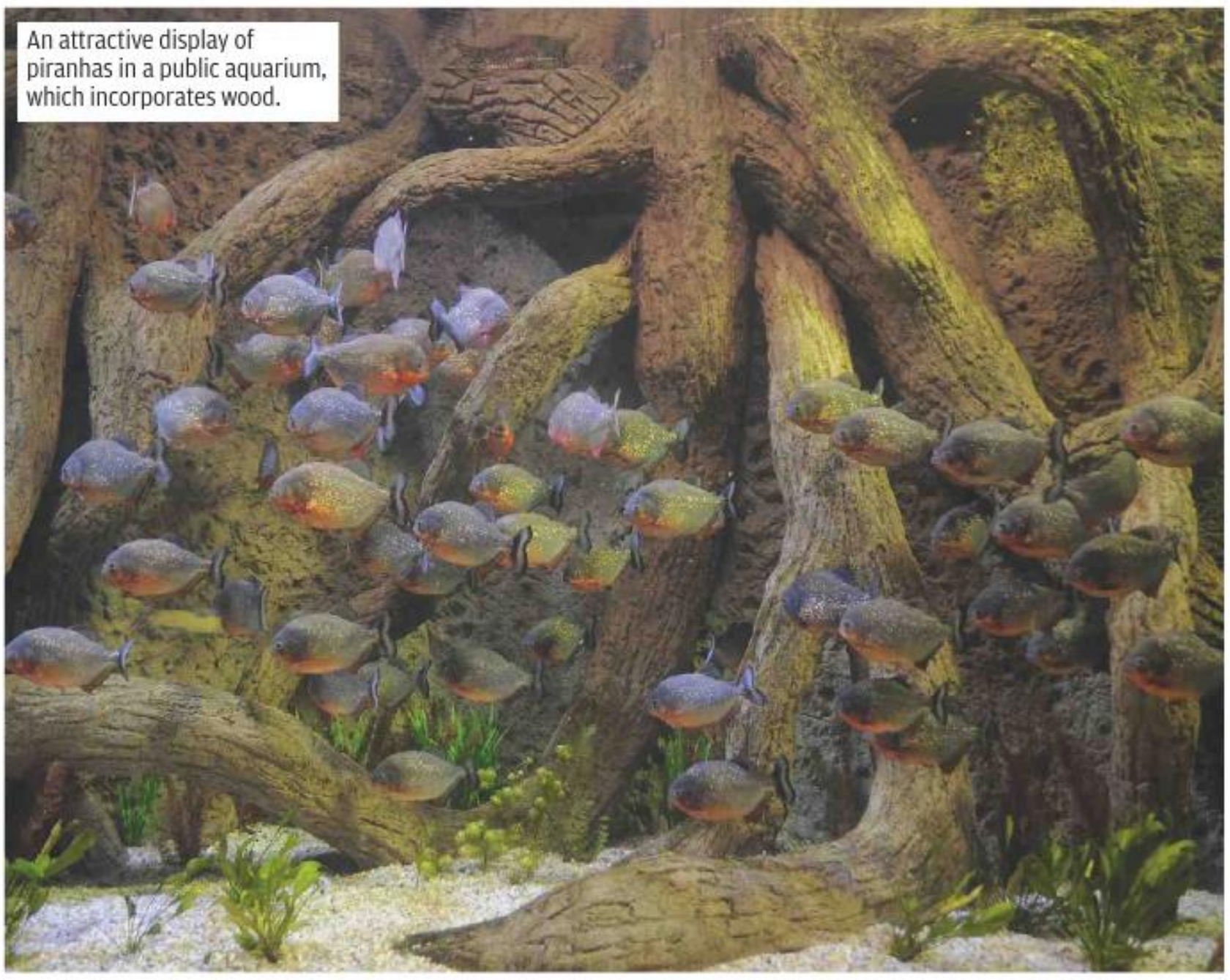
Piranhas should be kept at a temperature of 26°C (80°F), so you will need a heater-stat unit to maintain them in the warm water conditions in which they will thrive.

Naturally, this will also mean that you will have to have a thermometer in the tank as well, in order to monitor the water temperature.

However, it is a mistake to maintain these fresh water fish at too high a temperature. If they subjected to lengthy periods during which the water temperature is maintained at a higher level, this can result in heart disease, respiratory problems and nerve damage. Always remember that the higher the temperature of the water, so the lower will be its oxygen content.

It may seem strange, but in my experience, piranhas are extremely susceptible to damage being caused to their immune system. This will leave them vulnerable to all manner of diseases, including mouth rot and swelling of the abdomen, known as dropsy. Likewise, maintaining them at too low a temperature, or exposing them to a sudden drop in temperature can depress their immune system too, with harmful consequences.

If you happen to live in an area where the water is very hard, thanks to its lime content, you will need to soften the water, to create the conditions which suit these fish best.They favour soft, acidic water, with a pH reading of 6.5. If you include bogwood in the aquarium, as a means of providing them with cover, then this will have the added benefit of helping to raise the acidity of the water. Even so, regular monitoring of the water chemistry will be vital, so as to ensure that conditions remain suitable, augmented by regular water changes as usual.



An attractive display of piranhas in a public aquarium, which incorporates wood.

CONTINUES ON THE NEXT P52

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Keeping odd numbers of these fish together seems less likely to lead to outbreaks of aggression.

## Avoiding conflict

In an aquarium, an individual piranha will need a fair amount of space and, as a general rule, should be afforded approximately 9l of water per 2.5cm (2 gal/in) for a mature specimen. Personally, I would not advocate keeping piranhas in any tank with a capacity of less than 90-130l (20-30gal).

There can be conflicts between piranhas, and for some reason, it helps to keep them in uneven numbers, such as groups of three, five and so on. This reduces the likelihood of bullying, which can lead on to the death of the weaker individual. Dividing up the tank with bogwood and securely positioned rockwork can also help, while leaving clearer areas for swimming.

Introduce the fish at the same time, so as to prevent any territorial disputes, and make sure they are of similar size as well. Trying to introduce another individual to an established shoal can be fraught with danger, and is not recommended, particularly in the home aquarium.

**"There can be conflicts between piranhas, and for some reason, it helps to keep them in uneven numbers, such as groups of three, five and so on."**

In the zoological establishment where I worked, I was fortunate enough to have very large tanks at my disposal, although obviously the majority of home fishkeepers will be more limited, both in financial terms and in the amount of space that is available to devote to housing a very large fish tank within the domestic environment.

You should always be particularly fussy when it comes to cleaning the tank. I have always found piranhas to be extremely messy fish. I would advocate changing between 10-15 per cent of their water on a weekly basis, so that they can always enjoy a clean environment. Any waste material which is not processed by the filter in the aquarium should be removed regularly with a siphon.

It helps to slope the aquarium gravel down to the front of the tank, creating a trough here. This means that any such waste will be clearly

**ABOVE** Young piranhas often display darker blotches on their bodies.

Older piranhas tend to become quite dark in colour, but they display variable amounts of speckling on their bodies.

visible, and can be removed more easily as well. It is very important not to let waste accumulate, as this can lead to a rapid deterioration in water quality.

Good filtration is essential to prevent the water from becoming harmful to this fish, with a build up of nitrogenous compounds arising from their waste and decomposition of any uneaten food. It is important to ensure that the filters are well maintained. It is also vital for the well-being of the fish that the filter is of sufficient size to cope with the water volume in the tank. Larger tanks need external filters, which have a larger throughput. If in doubt, always purchase a filter with a flow rate that is higher than strictly necessary, so as to ensure the water quality can be maintained.

Some piranha enthusiasts deploy multiple filters to maintain the cleanliness of a large tank. I personally prefer this course of action, as having several smaller filters, rather than a single larger one, will enable the aquarium keeper to stagger the maintenance routine.

In this, way you can also minimise the inherent risk of a sudden fall-off in water quality that can result if one filter should break down. In addition, you will not be changing all of the filter media at the same time, thus minimising the risk of recycling the bacteria which inhabit the filter chambers, and are vital to the overall health of the system.

## Feeding

Piranhas are naturally omnivorous; they will eat virtually anything and should therefore be provided with as varied a diet as possible. There are many excellent proprietary brands on the market, which will fulfil all their basic nutritional needs and frozen foods are likewise readily available. Try to vary their diet somewhat, as they eat different items in the wild, depending on the time of year.

Choose a formulated food intended for carnivorous fish, and it is better to offer pellets which they can grab, rather than flake food. You can also get tablets, as produced by JBL for example, that you can stick on the aquarium glass, making it easy to watch the piranhas feeding, but do not leave your fingers in the tank when

CONTINUES ON THE NEXT PAGE »

A varied diet suits piranhas well. They feed in the middle and upper reaches of the tank.

## Strange beliefs

Many people do not appreciate that piranhas also take vegetables and I am certain that the majority of visitors to the zoo where I worked for so many years, would have found it difficult to imagine a piranha chewing on a lettuce leaf!

Another daft belief frequently voiced by visitors was that in order to be safely kept in captivity, the piranhas in my care must have previously been subjected to the removal of all their teeth. Quite how any dentist could manage to extract a piranha's teeth was an abiding mystery to me! In short, it never ceased to amaze me as to what the public was capable of believing.

I would advocate providing as wide a variety of both processed and frozen foods as possible.They should always be offered fresh green vegetables, such as spinach and thinly sliced courgettes.

If you are feeding them the right amount, all the food placed in the tank should be consumed in a matter of minutes. If food items remain untouched for any length of time, then you are offering them more than they need to eat and rotting, decaying food will soon pollute your tank. It is important to feed your piranhas only once a day. If you feed them more frequently, this will only serve to increase the amount of waste being produced and some of this food is more likely to be wasted as well.

Removing the teeth from a living piranha would be impossible.
Photo courtesy Sarefo.

## Popular Fish Keeping — Expert tips

- Do not be tempted to feed your piranhas on meat. This will cause the water to become polluted very rapidly, and give it a highly unpleasant smell as well.

- In the wild, piranhas will sometimes nibble at the fins and scales of other larger fish. They will scavenge on decaying carcasses and, of course, they will take live fish. In the past, many people who kept piranhas believed that you had to drop a live goldfish into their tank every so often, in order to satisfy their carnivorous tastes. This is a complete fallacy and was an extremely cruel practice. It was also one of the easiest ways to introduce disease into the tank.

Piranhas are shy by nature.

sticking these in place! Food of this type will not usually cloud the water.

## Shy and retiring natures

Most people do not appreciate the fact that piranhas can be quite shy and retiring and should therefore always be kept in a well-planted aquarium, ideally containing some large rocks behind which they can hide, if they wish to do so. However, it is important to ensure that any rocks placed in their tank do not feature any sharp edges, which may inflict injury, particularly if your fish are startled at any time. The lighting above the aquarium should also be relatively subdued. Incorporating floating plants at the surface of the aquarium will help in this regard.

Unless they are kept in a fairly large school, certain individuals can be extremely reluctant to show themselves. In order for them to feel comfortable in an aquarium, they must have plenty of places in which to hide. As a general rule, at least half of the area of the tank should support a good degree of cover. Naturally, you will want to be able to see your fish and there will have to be a fairly open area within the tank as well, for this purpose.

As juveniles, piranhas will tend to form a natural school and they should always be kept in small groups. As adults, they may become more solitary and may even attack individuals of the same species.

If their tank is sufficiently large, they may be kept in the company of other species, although they may be guilty of taking the odd bite out of the fins of the fellow occupants of the tank. Personally, I would not recommend keeping piranhas with anything else – perhaps with the exception of some species of catfish.

## Charged debate

Piranhas are not the only freshwater species that can inspire fear in members of the general public. In the aquarium section at the zoological collection where I worked, I never ceased to be amazed by some of comments made by visitors. When I was attending to the tanks from the service passage at the rear, they would be totally unaware of my presence "behind the scenes" and I would be able to listen in on their remarks – some of which I found quite intriguing.

Second only to the piranhas in terms of generating fear and trepidation among visitors was the electric eel - although, accurately speaking, it is not actually an eel as such, but a member of the knifefish family (Gymnotidae). However, many of those visiting the

An electric eel *(Electrophorus electricus)*. Source: PD.

A clown knifefish – bottom right – in a public aquarium in the company of piranhas and other fish. These fish swim with a distinctive, rippling movement.

zoo would find the electric eel rather revolting. Whilst, to my mind, it has a certain beauty, I can appreciate that it is not to everybody's taste!

Knifefish move in a beautifully smooth manner and appear to literally "ripple" though the water. Their graceful movements are shown to best effect in a longer aquarium. I have always found it to be a pleasure to observe their sinuous movements. The body of these fish is long and tapered and, unusually, they are laterally compressed, meaning the body itself is narrow. It is this shape that is suggestive of the profile of a knife – hence their common name.

**"On the other hand, I would definitely not recommend an electric eel as an ideal occupant for the home aquarium!"**

These fish may be considered quite unusual and, to my mind, they make fascinating aquarium subjects. Certainly they are somewhat out of the ordinary, and although not perhaps the easiest of species to cater for, some members of the knifefish family can be kept quite successfully.

On the other hand, I would definitely not recommend an electric eel as an ideal occupant for the home aquarium! A large electric eel is capable of killing you instantly, as it can produce sufficient voltage to stop your heart beat, so even in professional hands, the use of protective clothing is necessary when attending to the daily needs of this species – rubber gloves and rubber boots must be worn at all times in proximity to one of these eels.

Nevetheless, despite the obvious drawbacks of keeping these potentially dangerous aquarium subjects, I think an electric eel has the ability both to enthrall and inspire awe at the same time. Unlike the piranha, which requires well-oxygenated water, electric eels can be found in muddy, stagnant water and even quite shallow water in the wild. They can survive by taking gulps of air directly from the water's surface. Another unusual aspect of this species is its ability to move backwards as easily as moving forwards – the vast majority of fish are unable to do this.

CONTINUES ON THE NEXT PAGE »

## Different knifefish

Knifefish form two distinct groups – the largest of which comprise the electric eel and the banded knifefish (family Gymnotidae), the glass knifefish (Sternopygidae), the sand knifefish (Rhamphichthyidae), the bluntnose knifefish (Hypopomidae) and the ghost knifefish (Apteronotidae). There are approximately 150 species altogether within this group of five different New World families. All of these are strictly freshwater species and are to be found in their natural habitat in Central and South America.

The second group of knifefish comprise the Notopteridae family, which are otherwise known as featherbacks, or feather fin knifefish. They naturally occur in Africa and south-east Asia. This is a much smaller group containing no more than a dozen different species.

All the members of this second group are much smaller and although they swim in a similar manner, they are not closely related to the New World forms. On the subject of species which are related, many people do not realise that the diminutive neon tetra housed in tropical home aquariums all over the world is actually a close relative of the piranha.

Whereas species such as the piranha and the electric eel are quite awesome in some people's eyes, other species, such as the angelfish (*Pterophyllum*) are appreciated for their beauty.

Vistors to the zoological establishment where I worked for so many years could often be observed in silent contemplation of not just the elegant appearance of these particular fish, but also the way that they moved. They would often remain rooted to the spot in front of the tank containing a large school of these fish.

Interestingly, angelfish also have the ability to move backwards and can appear to be shying away from anyone observing them.

A royal knifefish (*Chitala blanci*) – an Asiatic species. These fish can grow to 61cm (24in) or more.
Photo courtesy Peter17.

Angelfish are very elegant. House them in a deep aquarium, bearing in mind the depth of their bodies.

## Eel sense

As mentioned, when attending to the electric eel, I would always take the precaution of wearing stout rubber gloves, thick rubber boots and a rubber mackintosh. I looked rather like a fisherman who had just come ashore from a North Sea trawler. All that I lacked to complete the look was a bright yellow southwester – no wonder that in this get-up, I too was frequently the subject of some rather strange remarks – not to mention a certain amount of ridicule.

The electric eel at the zoo appeared to recognise me, although I am not quite sure how it did so, as the eyesight of this species is naturally extremely poor.

Unlike the piranha, which has quite large eyes in proportion to its body size, the electric eel has tiny eyes. These

Bill soon found himself heading out to sea.

appear to be noticeably shrunken relative to its size.

However, when I approached the tank, either from above on the working platform installed for the use of the staff, or from the public viewing gallery, it seemed to respond to me by immediately coming to the location where I was present. I guess that I was treated in this manner because I provided the food!

In the wild, an electric eel will stun its prey, but at the zoo, I provided a staple diet of strips of raw fish, such as cod, haddock and herring. As a species, electric eels are not generally fussy eaters and the individual in my charge would readily accept whatever was available to me when I visited the local wholesale fishmongers at nearby Newhaven.

I enjoyed a good relationship with several of the fish vendors, as it was always necessary for me to purchase large quantities from them for various occupants at the zoo. I would also always share a laugh and a joke with the local fishermen when they delivered to the park and they would enquire as to what "fish the fish were eating" as opposed to "what fish the public were eating" in the park's cafeteria!

## A thoughtless remark...

On one particular occasion though, I remember making an idle comment that I would like to go out with them on one of the shorter overnight fishing trips. It was a bitterly cold morning in the middle of February, when I made the remark over a mug of steaming hot coffee in the staff room, when one of the fishermen was delivering fresh supplies.

What I had not meant was that I wished to make the trip the following week, when the weather was still bitterly cold. But I couldn't seriously back down, once I was given the opportunity. So on a wild and windy night, I found myself sailing out of Newhaven harbour and into the Firth of Forth.

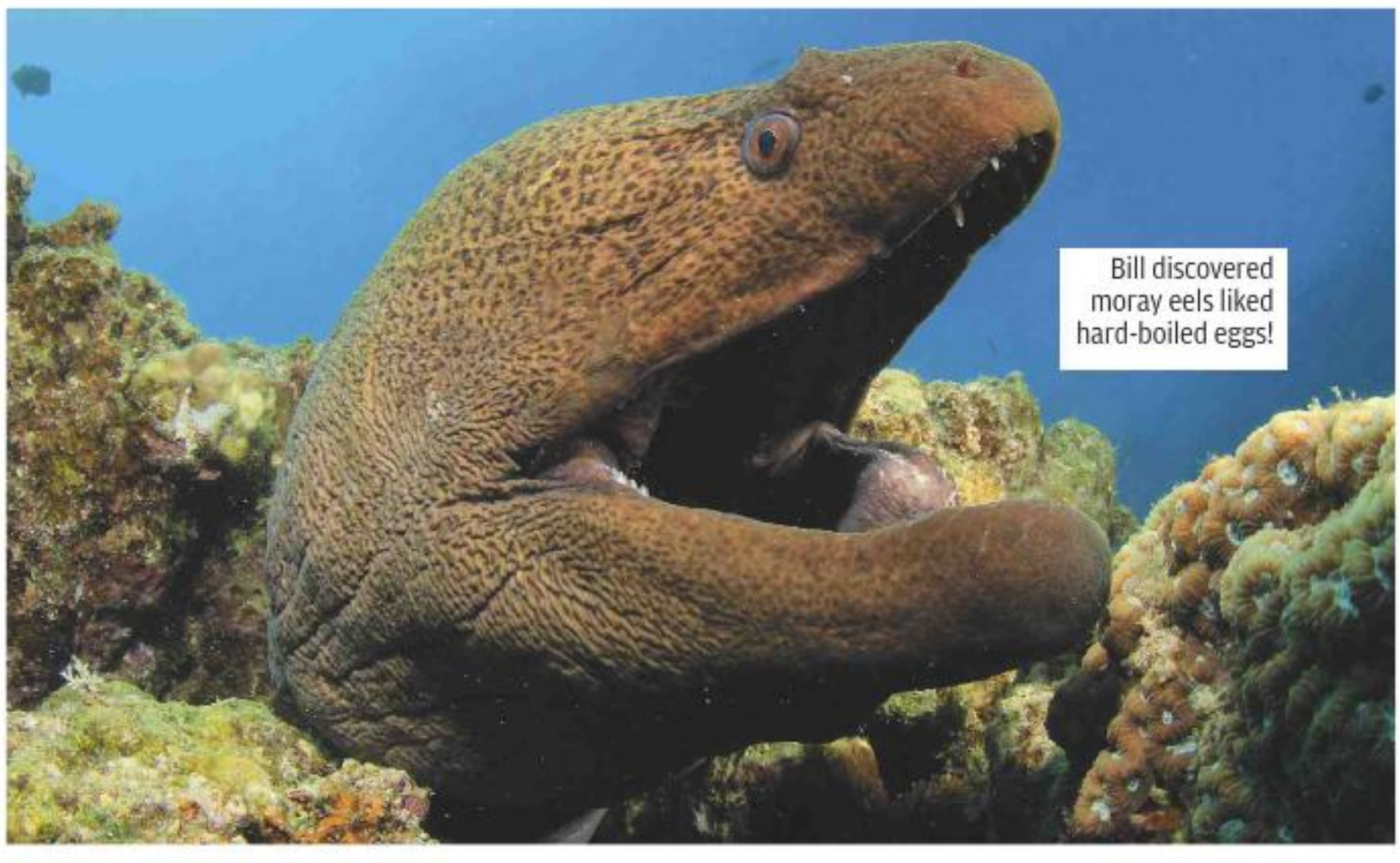
When we finally docked again in the early hours of the following morning, never did I imagine that I would ever feel warm again. However, my experience did fill me with admiration for the trawlermen who go out to sea in all weathers, night after night, risking the elements in order for me to be able to pop into to my local fish and chip shop on a Friday evening for my haddock and chips, or to be able to drop a few sprats into the hungry mouth of an electric eel.

## And a strange discovery

I guess that on that freezing cold night it was a case of "I'm a zoo keeper, get me out of here". It is surprising to me how people dislike eels – perhaps because of their snake-like shape? Personally, I have never had any such qualms. On a holiday to the Maldives with my partner, we would wander down for breakfast dressed only in our swimming gear. One item that was always on the breakfast menu was hard-boiled eggs – something which the moray eels occupying the surrounding reefs appeared to relish.

Each morning I would therefore smuggle a few hard-boiled eggs out of the restaurant for them. However, dressed for breakfast only in a pair of swimming trunks, the best way of concealing my ill-gotten gains did present something of a problem. All I could do was to stuff the eggs into my swimming trunks!

I fully understood why I would receive some rather strange looks from other holiday-makers when I left the restaurant. But I guess that having worked for so many years as a zoo-keeper, I had learnt to become extremely resourceful!



Bill discovered moray eels liked hard-boiled eggs!

Platies were amongst the first aquarium fish that Keith kept.

# Meet the stamp-collecting judge

It is interesting how, when you have a particular hobby that you are passionate about, this in turn can lead you into another hobby too, as **Susie Kearley** discovered when she spoke with Keith Cocker.

**SUSIE KEARLEY**
Aquarium writer

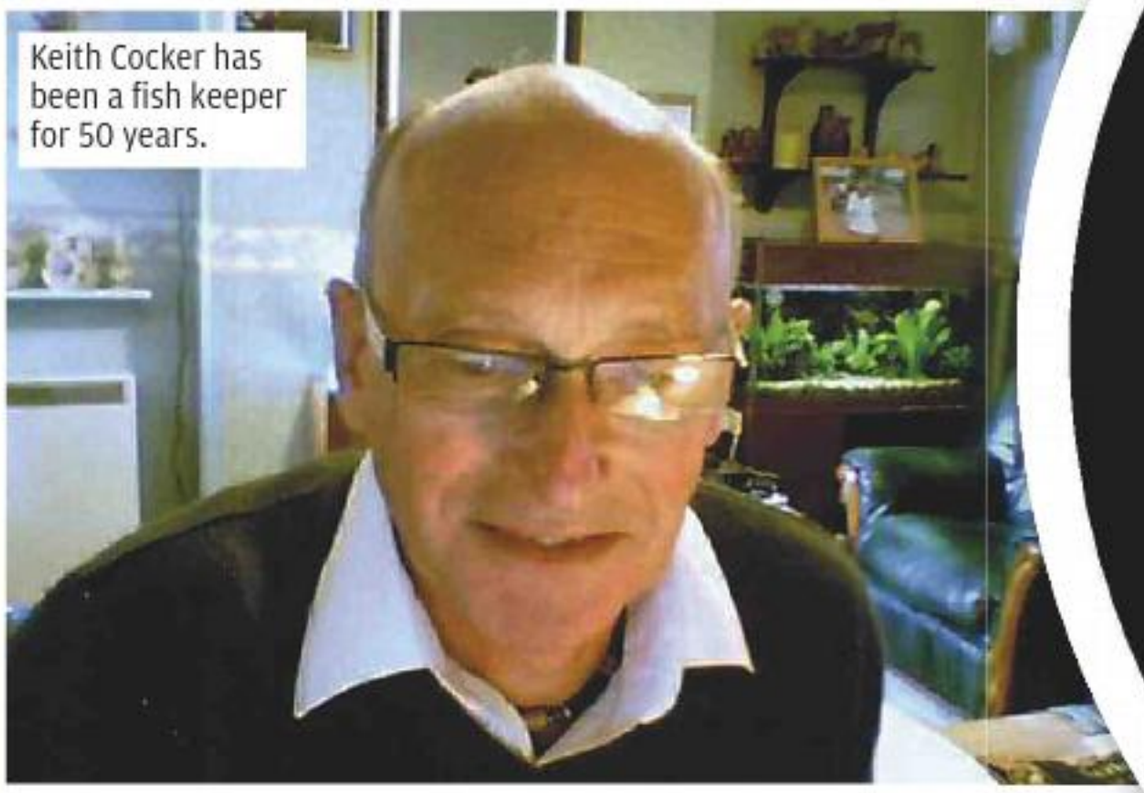
Keith, who lives in Ipswich in Suffolk, has now been keeping fish for 50 years, and has seen many changes in the hobby over that time.

**SK: How long have you been keeping fish?**

**Keith:** It was back in 1963, when I had left school and started work that I decided to purchase my first tropical fish aquarium. It was a 90cm (3ft) angle-iron tank, with the glass being held in place by putty, at a time long before silicone sealant had revolutionised tank construction. A friend of the family introduced me to some local people who kept fish and had fish houses, and they supplied me with my first fish. These were all therefore home bred, and included danios, barbs and livebearers such as platies, swordtails and of course, guppies.

**SK: When did you first become involved in exhibiting?**

**Keith:** I heard about the Suffolk Aquarists and Pond-keepers Association in Ipswich, and decided to attend a meeting. I enjoyed it, and so I requested to join the club. Back in those days, it was quite formal and you had to be proposed, and then seconded to become a member. Fortunately, they liked me and I was voted in! I soon became more involved and took part



Keith Cocker has been a fish keeper for 50 years.

A black backdrop can enhance the appearance of a fish, as seen here in the case of this male Siamese fighting fish.

Show guppies being exhibited in clear glass tanks.
*PHOTO COURTESY CARL STEWART.*

in the monthly table shows and annual exhibitions. This led to me taking part in open shows organised by other clubs. After many years in the hobby, I became the club's secretary, show secretary and then I was finally made the vice-president. But unfortunately, since those good old days, interest waned and the club has been wound up!

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

**Keith:** During the late 1970s and in the 1980s, I was involved in getting all the East Anglian clubs to join together and form an area group, known as the East Anglian Federated Aquarists. It was then that I got involved in judging. Sadly most of the clubs involved in this initiative have now closed, but I am still a member of the very fine Norwich and District Aquarist Society.

In April 1973, I was graded a 'C' class judge with the Federation of British Aquatic Societies (FBAS). Then after many years judging at Federation open shows all over the country, I passed a test to become an 'A' class judge, and was upgraded in 1980. I am now a senior judge and also chair the FBAS Judges and Standards Committee.

**SK: Can you explain how you judge fish?**

**Keith:** Fish are shown in glass tanks, measuring a minimum of 10x10x10cm (4x4x4in). The tanks can have a black bottom but all vertical sides must be clear, or brown gravel can be used on the base, to a depth of 2cm (0.8in). Exhibitors can therefore show fish in tanks with a clear base, a black base or brown gravel. There should be nothing else in the tank.

**"Fish are shown in glass tanks, measuring a minimum of 10x10x10cm (4x4x4in). The tanks can have a black bottom but all vertical sides must be clear"**

The Federation's judges are all given pieces of equipment to make the job easier when it comes to assessing the various species that are being shown. Each year, the FBAS issues size sheets that list the size to which a fish is supposed to grow. We measure each fish with our refraction rule and check this figure with with the size sheet.

Then we allocate the points for size, finnage, colour, body shape and condition, as well as for deportment and presentation. As a general guide, we are looking for well-grown fish, with good colouring and well-shaped fins. They must also be in top condition and well presented.

At each Federation show, my committee appoints a senior judge. It is then his or her job to distribute the judging sheets to the judges at the show. The Federation of British Aquatic Societies allocates championship classes

**ABOVE** Condition and fin quality can go hand in hand. The top of the caudal (tail) fin of this blind cave fish is showing signs of damage.

**TURN OVER FOR MORE ABOUT FISH JUDGING »**

Improved lighting technology today has made it much more feasible to create stunning aquatic landscapes, as seen here.

at each show, with the winners selected to go forwards to the annual Festival of Fishkeeping, to compete in the Supreme Final.

We also run a diamond class at each show. The diamond class is for a class of fish that the host club nominates for its own open show, with the winner taking part in the diamond final at the Festival. Each open show has a different class, so we have quite a lot of fish in the final.

**SK: Why does the hobby continue to hold your interest after half a century?**

**Keith:** Fish keeping is a very rewarding hobby. I have made many friends all over the country at shows and club meetings. It's great to meet people that have the same interests and we offer help and support to each other, as part of our hobby. Fish keeping itself is also a very relaxing hobby.

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

**Keith:** I am interested in all species of tropical fish, but my favourite groups are probably characins, barbs and loaches, with my favourite being the clown loach (*Chromobotia macracanthus*).


**LEFT** Some of Keith's fish stamp collection.
*PHOTO COURTESY OF THE AUTHOR*

**RIGHT** Aquarium fish food is now scientifically formulated, to correspond as closely as possible to the needs of the various fish that are now being kept.

**BELOW** A swordtail - one of a set of stamps featuring tropical fish, issued by Nicaragua.
*PHOTO ALEXANDER ZAM/SHUTTERSTOCK.COM.*


**SK: How has fish keeping and showing changed in that time?**

**Keith:** The hobby has come a long way since I started fish keeping in 1963. The advent of air travel has enabled so many new species to be introduced and the internet has helped too, by making available much more information about the hobby, putting fish keepers around the world in touch with each other. Developments and research into the nutritional needs of fish and how to feed them has led to an excellent range of foods being available today. All the well-known food brands are so good now.

**SK: Do you have any tips for people interested in showing their fish?**

**Keith:** If there is a local aquatic society near you, it's well worth joining to get information and guidance about all aspects of fish keeping. The Federation of British Aquatic Societies has an excellent website where information about societies

**RIGHT** Accurate measurements are important for judging purposes. A harlequin rasbora is shown here.

and shows can be obtained, and much else besides.

**SK: I understand that your interest in fish keeping has also led you into another hobby entirely? Please tell me more ...**

**Keith:** Yes, I've become an avid thematic stamp collector. This means that I don't collect the stamps of a particular country, but seek out all those which feature fish! I have about 650 stamps with fish on them at present, and they're all different. The collection is growing slowly. I enjoy adding to it when I get time. I buy my stamps though dealers on the internet and through eBay. Every now and then, I contact my suppliers to see if any new stamps featuring fish have been released.

In truth, stamp collecting was a hobby that I started when I was younger, and then as I began to get interested in fish keeping, I thought it would be a good idea to specialise in stamps with fish on them. I also found it was a good way to learn about geography! Now I'm retired, I want to study more about stamps. Also, being fish mad and single, I also have an ambition to meet a nice blonde mermaid!

The clown loach is Keith's favourite fish.

# INTRODUCING THE FEDERATION OF BRITISH AQUATIC SOCIETIES

The Federation of British Aquatic Societies (FBAS) was founded back in 1938, and is the largest fish keeping organisation in the UK. Part of its role is to support members' shows, and affiliated aquatic societies can apply for a show pack containing tank labels, place stickers and judging sheets, as well as other useful items for their show. The Federation also stores, coordinates and distributes aquatic goods offered by sponsors in support of aquatic societies.

FBAS championship classes are available for shows around the country and a trophy is supplied to the hosting society, which pays a small handling charge on top of its annual affiliation fee. Winners and runners-up in these classes qualify to take part in the coveted supreme championship held every year at the FBAS's Festival of Fishkeeping.

Best in show winners at fish shows across the country qualify for entry to the Federation's British Open Fish Competition. The FBAS Show Rules and Show Standards are well-respected. Judges, trained and graded by the Federation, officiate at all levels of competitive showing, ranging from small-scale table shows to open shows.

Monthly meetings of the Judges and Standards Committee ensure that every latest development and trend is taken into consideration for the continuing quality of the show rules. Every three months, the FBAS holds a General Assembly Meeting at which delegates can debate, and vote on, matters of aquatic interest to societies.

## *Information and advice*

The FBAS has a extensive range of useful publications, many of which are available as free downloads on their website. The publications include a wide variety of aquatic topics. The top-selling booklet entitled *No 6: The National Show Fish Sizes* is available, and FBAS publications also cover topics such as forming a society, and the organisation of open shows.

The website contains a wealth of information about FBAS services including details of judges, speakers, audio-visual programmes, a show and events calendar, and places of aquatic interest. The Federation's quarterly magazine, *The Bulletin*, can be downloaded online.

Their speakers are all experienced fish keepers, who are available for talks at society meetings. Member societies enjoy free hire of tape and slide aqua-talks and videos – and they're available to non-affiliated societies at very reasonable hire rates too.

**ABOVE** Dwarf gouramis – members of this group of fish are often to be seen at shows.

The FBAS enjoys healthy cooperation with other similar aquatic organisations both in the UK and abroad. A standardised set of aquarium fish sizes has been agreed, which allows the exhibiting aquarist to travel to aquatic events with confidence. This is particularly appreciated at such large aquatic events as the Federation's annual Festival of Fishkeeping. This major event attracts aquarists not only from the UK but further afield as well.

Through its continuing efforts, the FBAS actively encourages responsible fish keeping, no matter whatever your area of interest or level of proficiency. Care sheets and codes of practice are available to help owners give their fish the best possible care, and free advice is available to everyone.

## *Contact point*

If you want to find out where your nearest aquatic society is based, then contact the FBAS. Alternatively, if there isn't one close to you, they will advise you on how to form one! For more information, please contact the FBAS General Secretary on 01424 431016 or visit www.fbas.co.uk

# Reports of invisible fish

Fish have developed a number of different methods of camouflage, ranging from body shape to colouration, and some have ended up being almost invisible as a consequence. **Dr Karl Shuker** explains more.

There are several species of fish familiar to tropical freshwater aquarists that are virtually transparent. These include the X-ray fish (*Pristella maxillaris*), which is a form of tetra, the glass catfish (*Kryptopterus bicirrhis*), and the ghost catfish (*K. minor*). But what about an entirely transparent, invisible fish?

By definition, no-one has ever seen such a creature, because if they had done, it can't have been invisible – or can it? During my cryptozoological researches, investigating animals whose existence is reported but still unproven to science, I uncovered a very intriguing account of an allegedly invisible species of catfish, encountered and documented at first-hand by a well-known zoologist. As will be revealed in this article, however, it has turned out upon further investigation to be something far removed from its original description.

**LEFT** Karl was initially investigating reports of a fish with the ability to vanish that had been reported off the Seychelles.

## One mystery gives rise to another

Serendipity plays a not-inconsiderable part in cryptozoology, at least in my experience, because as has happened on a number of other occasions, I came upon this particular case while investigating a totally separate one!

This unrelated report had been brought to my attention by Gerald L. Wood, the author of all three editions of the exhaustively researched, and still-definitive book on zoological superlatives, *The Guinness Book of Animal Facts and Feats*. He was also a longstanding friend of mine. In a letter to me dated 1 July 1990, referring to a number of different mystery animals, Gerald included the following brief but tantalising enquiry:

"*Do you know anything about a new species of fish that can make itself invisible? Discovered near coral reefs off the Seychelles in the Indian Ocean, this mysterious creature turns from black to grey before 'vanishing'!*

The Asian glass catfish, a species well-concealed in plain sight, thanks to its transparent appearance.

The X-ray fish, so-called because of the appearance of its body, which allows its skeleton to be seen.

*Apparently a pair sell for £15,000!"*

I had certainly never heard of it before, but knowing Gerald well, I had no doubt that this was a serious request on his part, not a joke; if he was asking me for information concerning such a fish, then he definitely believed that it existed. So I promised him that I'd look into it, and would get back to him with any news that I could find. Tragically, however, this was not to be, because only a short time later, Gerald died suddenly. And despite my efforts, I never did succeed in adding any details to those scant ones supplied by him.

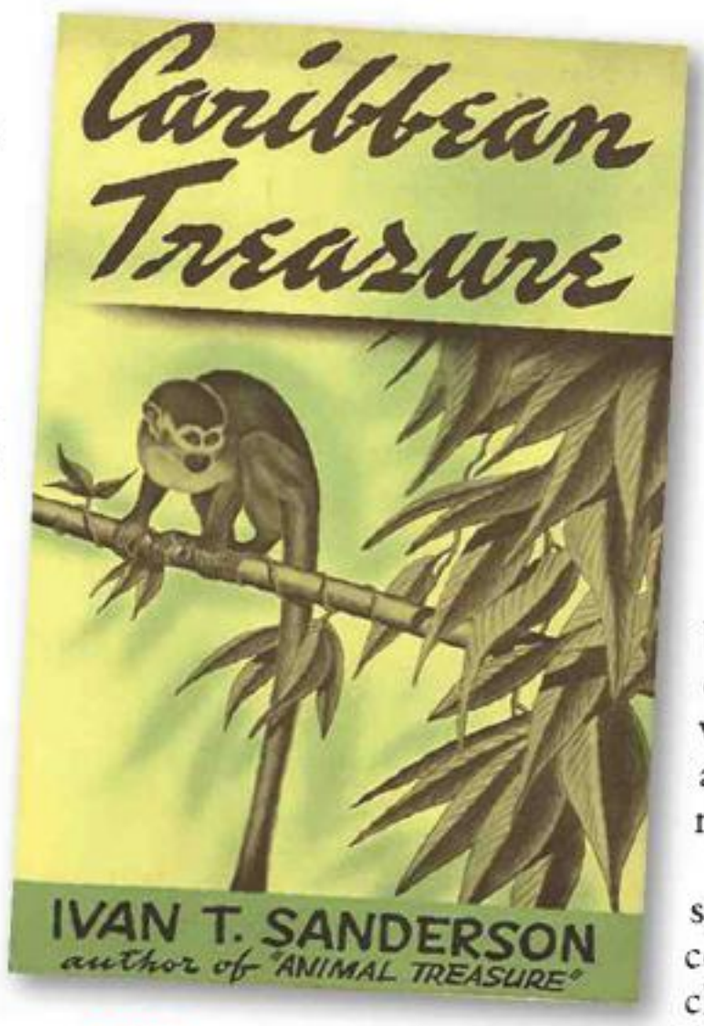
Of course, this episode took place several years before the internet became an unrivalled source of instantly-accessible information. So a few years ago, after recalling Gerald's invisible mystery fish and re-reading his letter referring to it, I pursued it again, but this time online, to see if anyone else had ever reported such a remarkable creature.

## A switch to the Caribbean

Sadly, however, I still failed to locate any information, but during my internet researches I did learn about what sounded like a genuine invisible catfish, indigenous to a particular freshwater cave pool on the Caribbean island of Trinidad.

The internet reports had originated from information in a book entitled *Caribbean Treasure*, which was first published in 1939. It had been written by Ivan T. Sanderson (1911-1973) - a Scottish-born American zoologist who was also an animal collector, zoo founder, prolific nature-travel writer, and a notable television personality in the States (being in many ways, therefore, a direct counterpart to Britain's own Gerald Durrell).

As related by Sanderson in his book, he had been conducting a field trip to Trinidad's Northern Range when he was informed by his local guides that a certain pool at the foot of the first vertical drop of the Oropuche (or Cumaca) Cave was the only known habitat of a rare and unique species of catfish that was so colourless and transparent that it could only be detected by observing its shadow passing across the bottom of the pool.




**ABOVE** Sanderson's book, called *Caribbean Treasure*, where he first described the mystery, invisible catfish.

Sanderson identified this elusive species as '*Caecorhandia urcihi*' [which was actually a misspelling – it should have been *Caecorhamdia urichi*], and stated that it was totally blind. Perhaps as a result of its invisible nature, no specimen of this catfish was captured by Sanderson or his helpers, even when using a torch beam in the hope of illuminating it somehow.

## Different findings

That, at least, was Sanderson's claim concerning the species. The reality, however, as I discovered when seeking out more information regarding this mystery catfish, is very different indeed. It was first brought to scientific attention in July 1924, when Trinidad-born naturalist Friederick W. Urich sent a specimen to London's Natural History Museum. After studying it, in October 1926 museum ichthyologist John R. Norman formally described and named its species *Caecorhamdia urichi*, in honour of Urich.

During the mid-1950s, six additional specimens were collected in its cave pool by Prof. Julian S. Kenny, the foremost expert on Trinidadian freshwater fishes at that time. After studying them in aquariums maintained at his home, Prof. Kenny concluded that they did not constitute a valid species in their own right though, but were merely a cave-dwelling (or 'troglobite') variety of *Rhamdia quelen* - a common catfish species in rivers throughout Trinidad.

Moreover, these six specimens varied greatly in colour, from dark grey-charcoal to pale pinkish-white. Yet all were readily visible, being quite thick in shape (as opposed to the extremely thin, flattened shape that one would expect for a reputedly transparent fish), and had therefore been easily captured.

And whereas the pale specimens were indeed eyeless, the darker ones possessed small but well-formed eyes. Clearly, therefore, Sanderson's description of this catfish form was incorrect on a number of crucial counts. In addition, I remain baffled at how anything rendered supposedly invisible by being totally transparent is able to cast a shadow anyway.

The location of the island of Trinidad, with its smaller neighbour Tobago lying to the north. *MAP COURTESY OF L'AMÉRICAIN.*

TURN OVER FOR MORE FISH MYSTERIES »

## Popular Fish Keeping Did you know?

Localised, cave-dwelling populations of species which have a much wider distribution are recognised elsewhere too. The blind cave fish (*Astyanax mexicanus*), shown right, from Mexico is descended from a tetra that is found in nearby rivers. Its ancestors are believed to have entered the cave system, and become trapped there thousands of years ago, possibly because of changes in the water level.

A Mexican blind cave fish.

### Further findings

In April 1966, the plot thickened further, when Dr G.F. Mees, a catfish expert from the Netherlands, attempted to catch some specimens in their cave pool. In contrast to Kenny's experience, they proved very difficult to capture, and when he finally did procure three specimens, Dr Mees was surprised to discover that two of these were normally coloured specimens of *R. quelen*, with normal eyes, while the third, although eyeless, was also normally coloured.

In October 2000, Dr Aldemaro Romero and Joel E. Creswell published a short article in *National Speleological Society News* concerning this fish and their January 2000 visit to its pool, where they observed dozens of specimens. Not one of them, however, was eyeless or showed pale, depigmented colouration.

On the contrary, their eyes each uniquely appeared to possess a *tapetum lucidum*, a reflective layer present at the back of the eye that makes them flash when illuminated by torchlight, as in the case of a cat's eyes. Romero and Creswell concluded that although there may well have originally been pale, eyeless specimens here, they probably became extinct following an influx of normally coloured, eyed specimens from a stream that had invaded their cave.

There is a notable precedent for this theory. In 1983, it emerged that a population of the Mexican cave tetra that had originally consisted of pale eyeless specimens had been wiped out in under 50 years following an influx of their original ancestors from a nearby river as the result of a flood.

### The situation today

At it stands, *C. urichi* is now regarded merely as a synonym of *R. quelen*, and the allegedly invisible nature of this fish as claimed by Sanderson (in what was ultimately dismissed by critics as an exercise in 'creative description') has been entirely disproved. A sad but perhaps fitting conclusion to this remarkable case – an invisible catfish that was not invisible at all in real terms, but was finally rendered so via taxonomy, essentially vanishing from the scientific record!

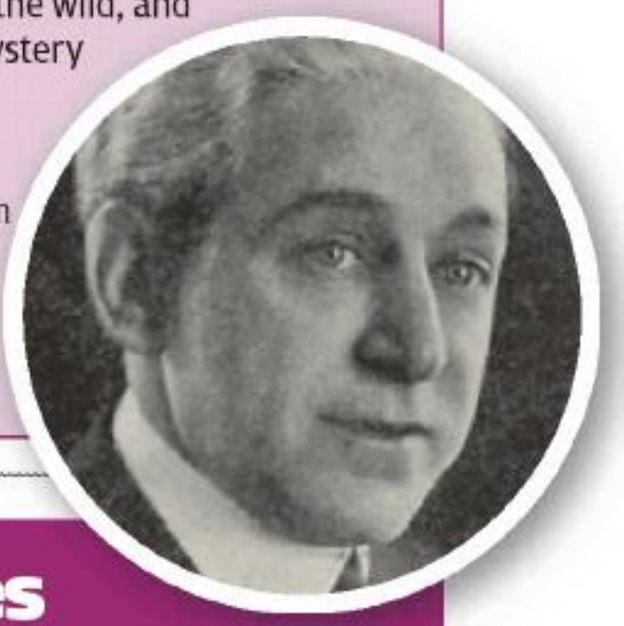
### The case of the Brazilian invisible fish

Finally, no article on invisible freshwater fishes could be complete without mentioning the infamous Brazilian invisible fish. Once a staple exhibit at any travelling sideshow or display of curiosities, it was generally housed within a large water-filled goldfish bowl, and the viewing public were invited to peer closely at the bowl in case they could discern this highly elusive and rare species.

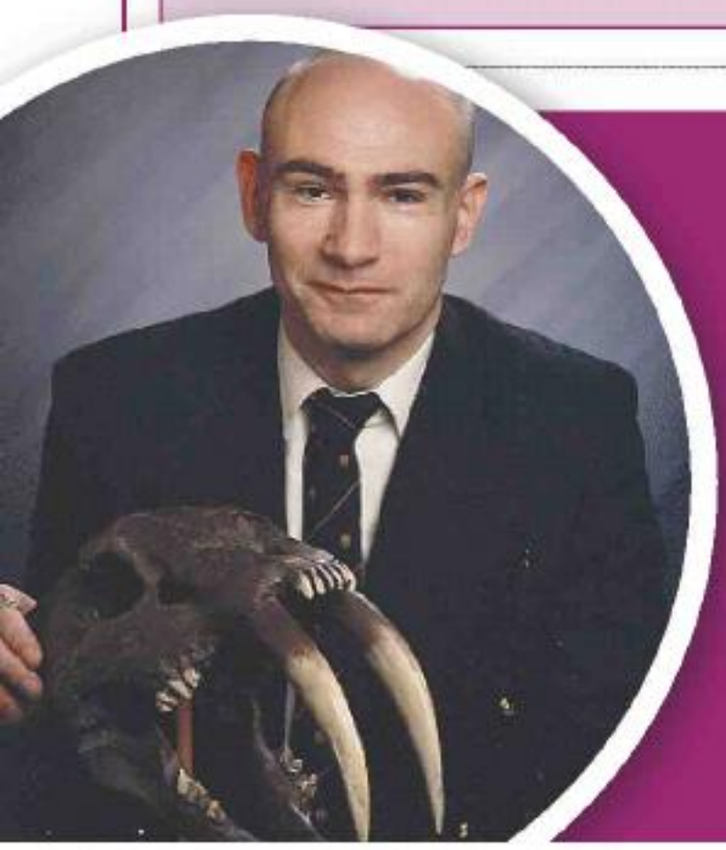
Some observers couldn't spy it, which is not really surprising, because there was nothing whatsoever in the bowl except for the water! The Brazilian invisible fish was, of course, a hoax, and first attracted notable attention when Harry Reichenbach (1882-1931), an American publicist, used this scam in order to attract potential customers to a poor woman's restaurant, by placing the bowl and a big sign advertising it in the store's window.

Amazingly, however, there would always be those who were adamant that they had definitely seen something move inside the bowl. Sometimes though, this was actually true, inasmuch as Reichenbach would strategically place a small electric fan out of sight but near enough to the bowl to create a faintly visible ripple passing through the water.

All of which goes to prove that there are none so blind as those who do *not* want to see. Equally, on the other side of the coin, there are none so perceptive as those who *do* want to see – the latter phenomenon being responsible for many sightings of so-called big cats in the wild, and of many other mystery beasts as well.



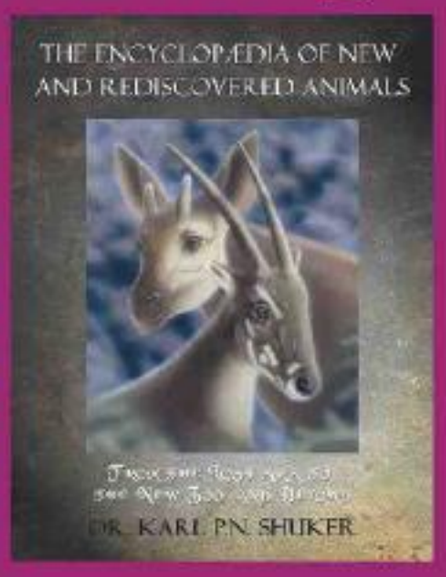
**RIGHT** The Brazilian invisible fish was created by Harry Reichenbach. *SOURCE PD.*



## 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.

# The water detective

Simon Hyland's aquarium was beautifully maintained. So why were his fish dying? As **Caroline Impey** discovers, the problem was almost beyond his control.

**CAROLINE IMPEY**
Aquarium writer

Simon with Christopher and Cloe, in front of their aquarium.

When Simon Hyland's children asked if they could start keeping fish, he saw no reason to refuse. After all, fish would be far easier to look after than many other pets. And besides, an aquarium of beautiful fish would bring a little peace and relaxation to his busy household. The children's great-uncle had been keeping fish for many years and was happy to donate a spare 30l (6.5gal) tank to the family to help start them off.

So, with excitement, Simon, 42, his fiancée Jo, 38, and their children Christopher, six, and Chloe, four, decided to set up the tank in their dining room. The family, who live in Greenhithe, Kent, were keen to keep tropical fish.

"We thought there was a lot of variety to choose from," explains Simon. "And, by choosing carefully, we thought they wouldn't be too difficult for the children to help with caring for them."

They prepared carefully, cycling the tank correctly, adding a beneficial bacterial culture to assist the development of biological filtration. Finally after cycling the tank for six weeks, the best bit came: choosing the fish.

## Starting off

"The children were so excited," recalls Simon, who works as an advertising manager for a magazine. "Christopher had been saving up his pocket money and he couldn't wait to spend it on our new pets."

The children chose a few guppies and an otocinclus catfish, and were thrilled to bring them home and watch them settle into their new home. It was a trouble-free start. All went well for many months – so well, in fact, that after 18 months of successful fish keeping, the family decided to buy a bigger tank to expand their hobby further.

"We wanted to have more fish," says Simon. "But obviously you're very limited as to how many fish you can keep in a small tank. We also wanted the tank to be more of a showpiece in our home. It was time to increase the size."

Christopher and Cloe had the idea to keep fish.

ALL PHOTOS OF THE FAMILY'S AQUARIUM COURTESY SIMON HYLAND.

## New additions

The family opted for a 132l (29gal) tank that took pride of place in an alcove in their living room. They added some live plants as well as artificial ones, and rocks and stones to add interest for the fish.

First, their existing fish were moved into the new tank, and then after that they gradually added three harlequin rasboras, two neon tetras, two kuhli loaches (which Christopher bought with his pocket money) and two orange fin bristle-nose catfish, whom the children named Bill and Bert.

While Christopher and Chloe were keen to feed and help maintain the aquarium, Simon took charge of the water checks and rigorously carried these out every week.

"I knew that more fish would place a heavier burden on the filter," he explains. "So I realised it was important to monitor the water regularly with test kits."

What Simon found strange was that the tests constantly came back showing the water was completely clear of nitrates – typically created in the aquarium by a breakdown of fish waste and any food left uneaten – that in large amounts is harmful to fish.

"It seemed a little odd," says Simon. "You would think there would be some level of nitrate. But I trusted the kits."

## Disaster strikes

Then, within just three weeks of moving into their new tank, the guppies began to die. "It was a difficult time,"

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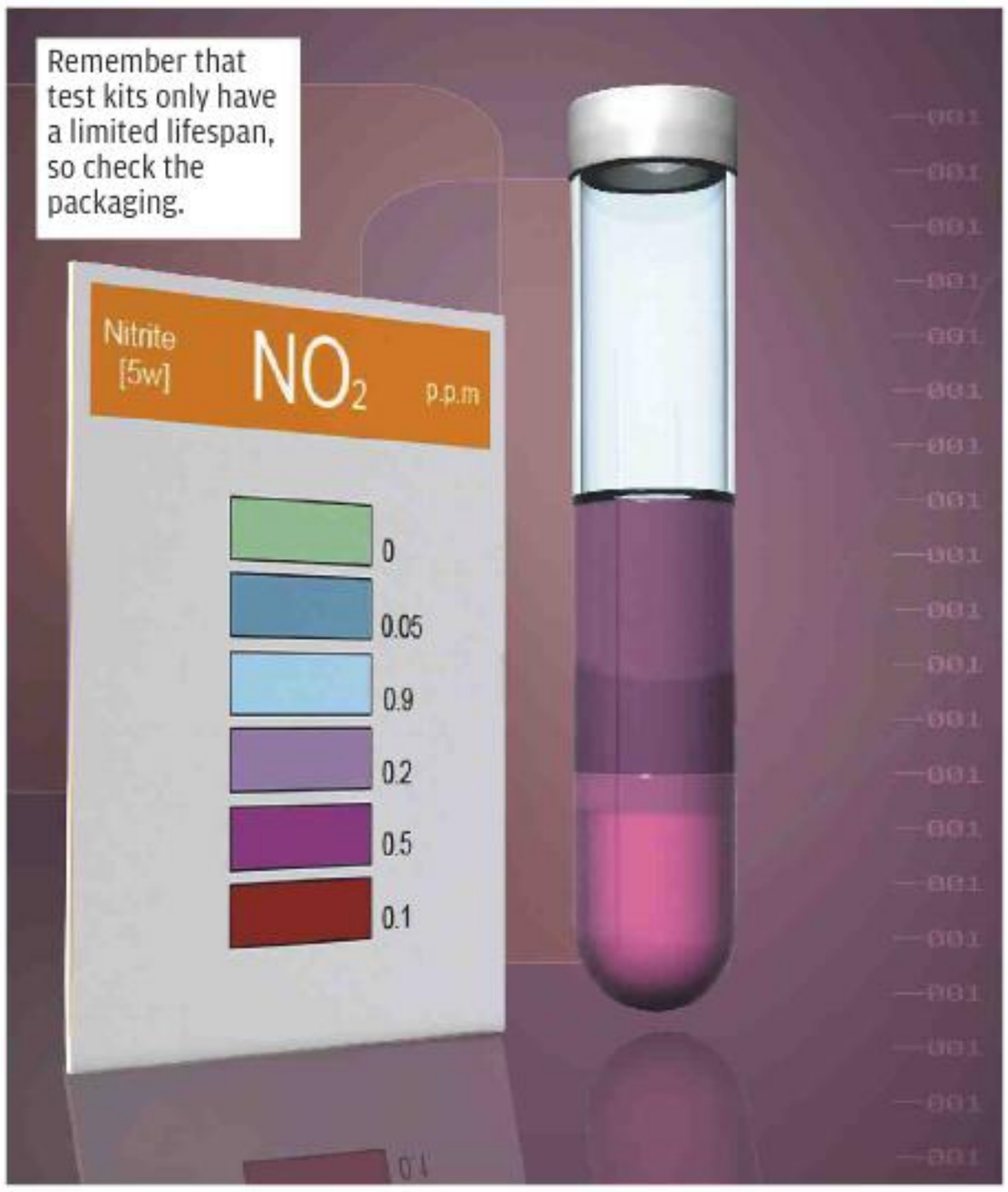
Bristle-nosed catfish have distinctive projections on their face.




Remember that test kits only have a limited lifespan, so check the packaging.

Simon admits. "These were the children's first fish and they came down in the morning and found them floating at the top of the tank."

Simon was perplexed as to why they had died, so he took a water sample to his aquatic dealer. To his horror, the nitrates in the water were in fact sky-high.

"I learnt at that point that test kits have a limited lifespan," said Simon. "I'd bought them online in good faith. But they were obviously too old and they hadn't been working for all these weeks that I'd been using them."

After that, Simon followed his aquatic dealer's advice, went home and did a 50 per cent water change, cleaned the filter and took out three-quarters of the gravel and cleaned that, too.

Then, in the days that followed, he did a 25 per cent water change every other day, adding the necessary water treatment to neutralise chlorine-based compounds in tap water that are otherwise toxic to fish.

## The problem remains

The ammonia levels, which had also been a little high, came down. And he expected the nitrates to come right down as well. But to his surprise they remained high and – worse still – more fish continued to die.

"I couldn't believe it," says Simon. "It didn't make any sense. I was doing all I could to replace that water to bring the levels down, and the fish were still dying."

All he could do was to roll up his sleeves, keep up the regular water changes and hope for the best. But when the loaches started dying too, he began to wonder what he had got himself into. It made him reflect. Surely fish-keeping is meant to be easier than this? How many more are going to die? The children handled it quite well, but it was still distressing for the whole family. Simon struggled to find answers to their questions as to how their fish had died.

## The cause is discovered

Then, one day, after almost three months of water changes every other day, Simon had an idea. He put the test kit under his kitchen tap – and suddenly

**"I was doing all I could to replace that water to bring the levels down, and the fish were still dying."**

Plants and fish in the aquarium.

# What's in Simon's tank?

An otocinclus catfish (seen right) is a popular choice for community tanks, and will help to keep algal growth here under control.

The family's aquarium is now thriving.

Effective filtration will help to control nitrate levels in the aquarium.

there was his answer: the water coming out of the tap was high in nitrate!

"I was shocked," admits Simon. "They were really quite high levels. And that was with no fish in the water!"

He then tested the tap water of Jo's mum Carole, who lived 32km (20ml) away, and it registered zero on nitrates. "It was incredible to realise what had been happening," says Simon. "All that time I'd been effectively fighting a losing battle."

At that point, there really was only one solution for Simon and his family. "We needed Jo's mum's water in our tank instead," he laughs, at the thought of what followed. Using large plastic tubs with secure lids, Simon drove 40 litres (9gal) of Carole's water home to his tank. Then, the next weekend he did the same thing, and repeated this routine the following week. Now it has now become part of the family's fish keeping ritual.

## A partial solution

In fact, Simon is such a dedicated fish-keeper that three months on, he still does a 64km (40ml) round trip to collect water for his water changes. And when Carole comes to visit the family, she always brings water with her. He also now uses Arcadia's Poly Filter to help to absorb the nitrates and maintain the water quality in the tank. But it does not actually solve the problem of course.

**"The tank now has lots of happy and healthy inhabitants."**

"It's not too difficult doing the water collections," says Simon good-naturedly. "I've got used to doing it now. Putting my own water in the tank just isn't an option so I don't see a way around it. If we ever move house, I'll be first person ever to ask an estate agent if I can test the house's water supply!"

Two people who are very pleased that Simon is so dedicated are Christopher and Chloe. The tank now has lots of happy and healthy inhabitants and the children are again enjoying looking after their pets (including new loaches) and don't have to worry about which fish will be the next to die.

"It's a lovely aquarium and we all enjoy watching them swimming around," says Simon. "It's been harder work than I thought it would be. I had no idea it was possible to have nitrates coming out of your tap. But at least we discovered what the problem was and thankfully our novel solution seems to be working."

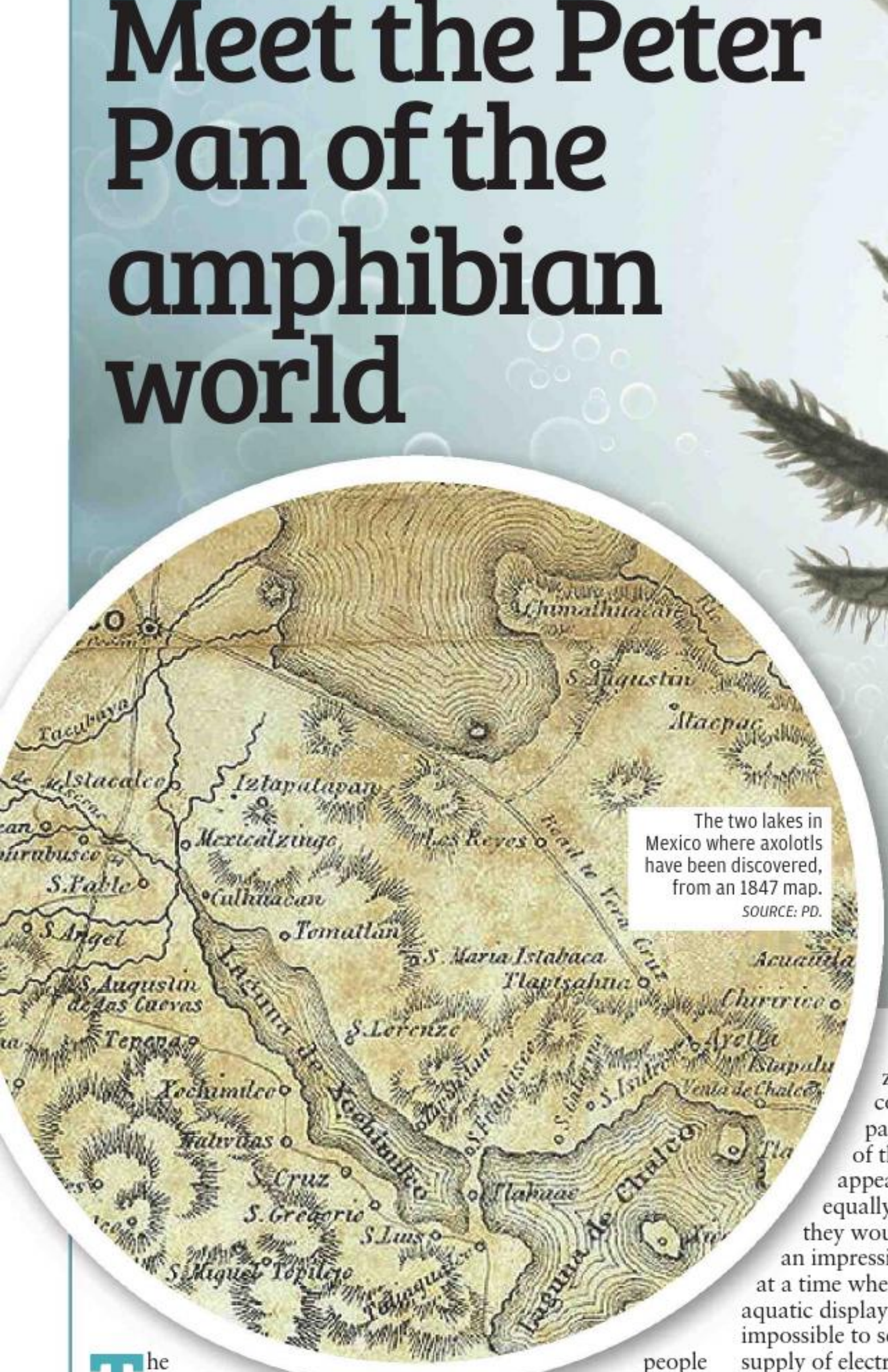
## Popular Fish Keeping Expert advice

Unfortunately, depending on where you live, your tap water may have elevated levels of nitrates. This is frequently caused by fertiliser run-off from fields polluting the groundwater supply. Elevated levels of nitrate in the drinking water may be harmful to people as well, so it is worth contacting your water company, to discuss this with them.

It is also possible to take steps to reduce the nitrate level by using an ion exchange resin. A unit for this purpose can be fitted unobtrusively adjacent to your kitchen tap, safeguarding both the family's health, as well as that of the fish. This should also pay for itself, compared with having to transport water from one area to another on a regular basis!

Just because you have an aquarium, you don't have to keep fish! There are other creatures that will thrive in these surroundings, as **David Alderton** reveals.

# Meet the Peter Pan of the amphibian world




The two lakes in Mexico where axolotls have been discovered, from an 1847 map. SOURCE: PD.

The axolotl (pronounced "axe-e-lot-al") is one of nature's oddities. The Spanish invaders of Mexico were the first Europeans to encounter this strange amphibian back in the 16th century. They recorded how the native people who lived around lakes Xochimilcho and Chalco regarded the axolotl as a sacred creature that could only be eaten at certain times of the year.

But this is only part of the story. Axolotls were popular exhibits in the early zoological collections, partly because of their bizarre appearance, but equally, because they would make an impressive display at a time when heated aquatic displays were largely impossible to set up, with no supply of electricity available, let alone any specialised equipment for this purpose.

The axolotl is sometimes described as the Peter Pan of the amphibian world, and for good reason, as was first observed in 1865 at the Jardin des Plantes in Paris. Keepers were amazed to see that some of the young axolotls bred there had lost their gills, and had emerged on to land. They had transformed into salamanders.

## Unusual biology

The axolotl (*Ambystoma mexicanum*) is highly unusual, because it can breed either as itself – effectively in the form of a giant tadpole – or as an adult salamander. This rare biological phenomenon of being able to breed in what is an immature state is referred to as neoteny.

**RIGHT** Early portrayals of axolotls in Europe, from a book published in 1897.

The axolotl's broad head is very apparent when seen from above.

**"They are easy animals to look after, requiring a reasonably spacious aquarium."**

It is now known that iodine plays a key part in stimulating the metamorphosis of all amphibians, including axolotls. If there is a deficiency in the waters where tadpoles are present, this transformation in their appearance does not take place. This does not just apply to axolotls, but to any amphibians – including our own frogs and toads, with people sometimes reporting that amphibian tadpoles of these species in their garden ponds do not transform into adults either.

The waters where axolotls occur are believed to be naturally very low in iodine, and so to counter this deficiency, and ensure the survival of the species, they have evolved to live and breed in this way.

Even so, they still retain the ability to transform into salamanders if the water level in their surroundings starts to fall progressively over the course of several months. The axolotls will then begin to lose their gills, with their body changing too, in preparation for breathing atmospheric air. Remarkably though, if the water level rises again, these effects will be reversed, with the gills enlarging again.

It has been shown that by adding a trace of iodine to the water, this will also encourage their transformation into salamanders. The iodine is absorbed into the body and used by the thyroid glands, located in the neck. They produce the hormone thyroxine, which is directly responsible for triggering the necessary body changes.

**LEFT** Mexico City - The axolotl has been displaced by a city that is now home to around 20 million people.

## The species today

Unfortunately today, the axolotl is regarded as being seriously endangered in the wild, as a result of loss of habitat and pollution. As Mexico City has grown significantly in area, particularly over recent years, so this has impacted dramatically on the lakes where these amphibians were originally discovered. In fact, they are not only polluted, but have also silted up, to the extent that they really no longer exist, other than as a series of canals flowing through the city.

## Accommodation

Axolotls grow to an average length of about 25cm (10in), although a few individuals have reached nearly 45cm (18in) overall. They are easy animals to look after, requiring a reasonably spacious aquarium.

It will be false economy to buy a small tank that you will then need to replace, so start with one that is approximately 90cm (36in) long and can be filled to a depth of about 30cm (12in). This will be large enough to accommodate an adult pair of axolotls if necessary.

It is recommended to cycle their tank, just as you would for a fish tank. Add a starter culture at the outset to populate the filter with beneficial bacteria that will ultimately result in the breakdown of ammonia to nitrate via nitrite. Test kits can be used for the purpose of checking how things are progressing, and subsequently once the axolotls have been introduced to their quarters.

No heater is required if the axolotls are housed indoors, and take care to position their quarters out of direct sunlight.

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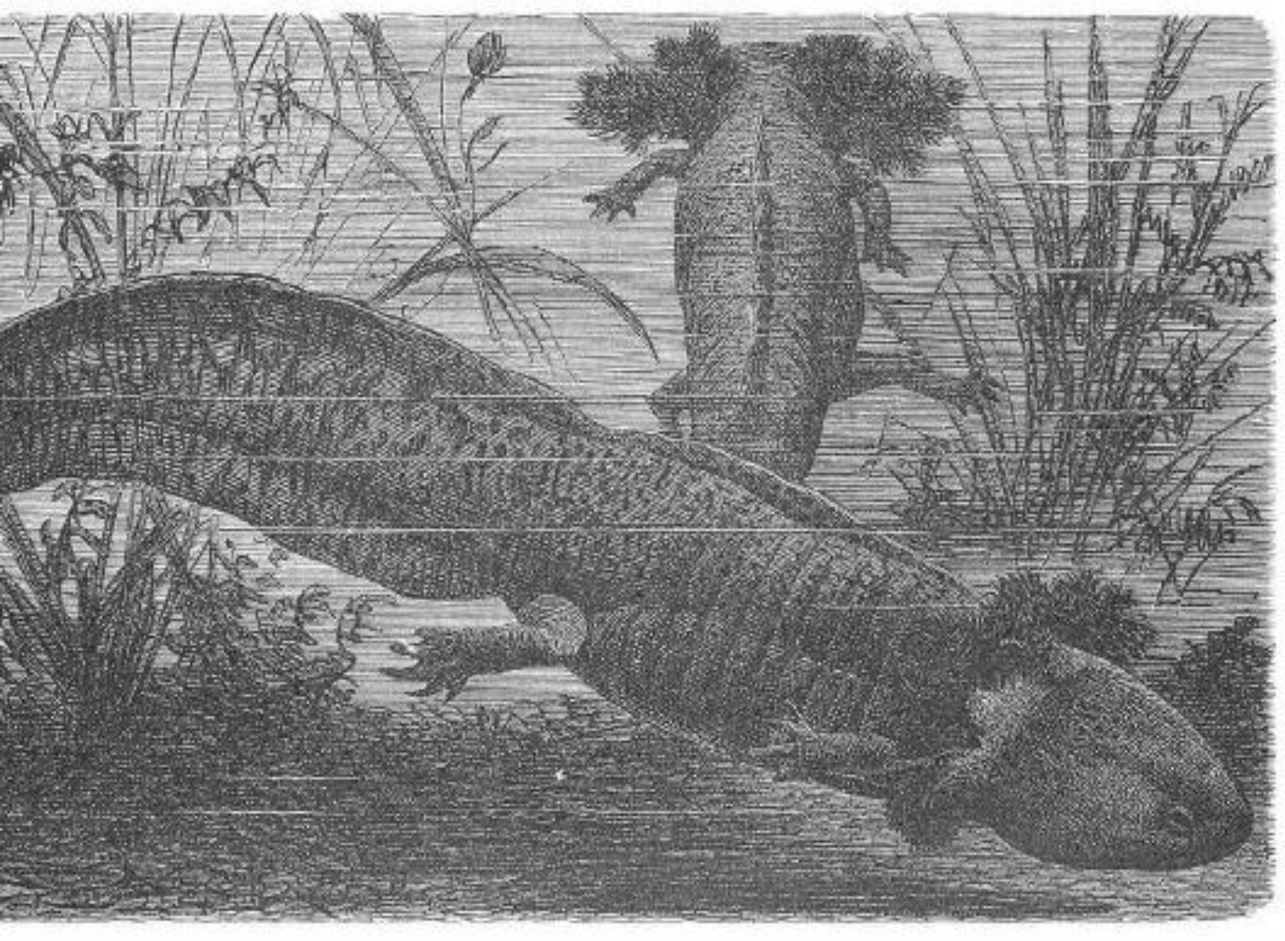
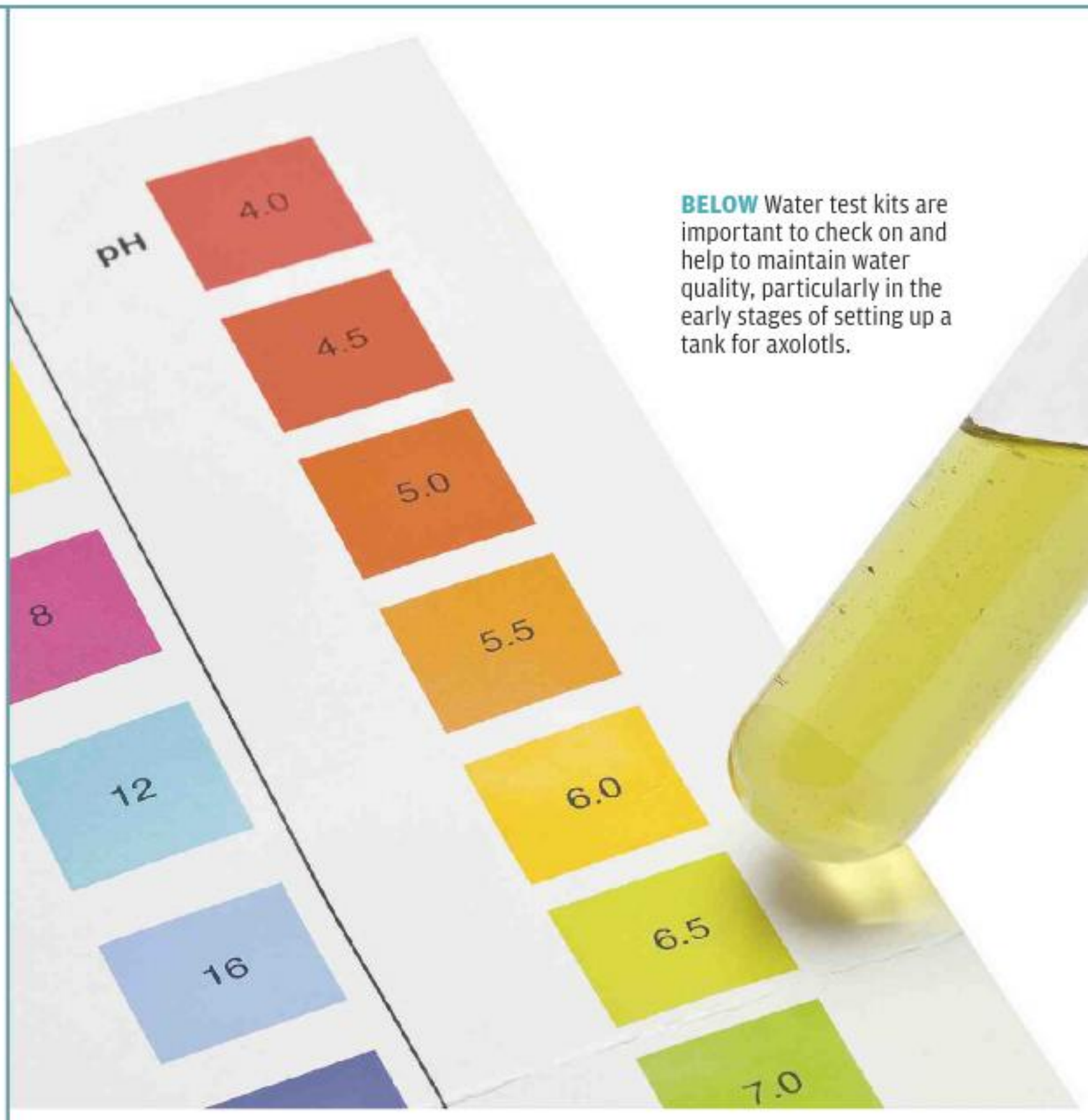


The aquarium needs to be adequately supported, as the weight of water will make it heavy.




**BELOW** Water test kits are important to check on and help to maintain water quality, particularly in the early stages of setting up a tank for axolotls.

This can trigger unsightly greenish algal growth on the sides of the tank, but more seriously, it can also lead to the water temperature rising to a fatal level, on a hot day.

## Substrate

The floor covering in the tank is largely a matter of personal preference. Do not use gravel though, as there is a risk that the axolotl will inadvertently suck in and swallow some of the stones with its food, which can create serious intestinal problems.

Some owners like to keep large pebbles on the floor of the tank, which, depending on their colour, can look striking, set against the axolotl. On the other hand, fine sand can also be used.

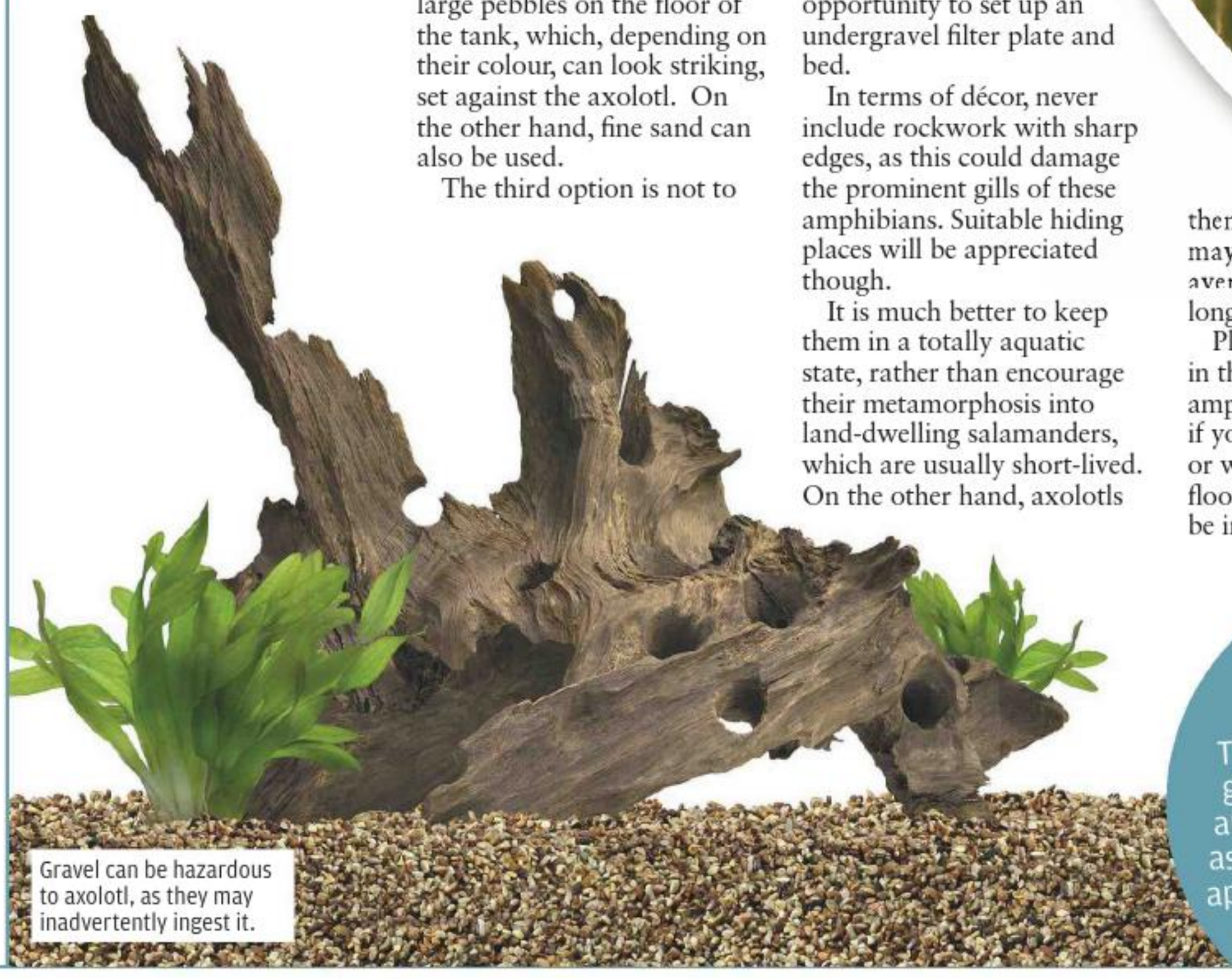
The third option is not to use any substrate. This may be preferable, simply on grounds of cleanliness, as it will aid filtration. A basic power filter will be required in any case, since there will be no opportunity to set up an undergravel filter plate and bed.

In terms of décor, never include rockwork with sharp edges, as this could damage the prominent gills of these amphibians. Suitable hiding places will be appreciated though.

It is much better to keep them in a totally aquatic state, rather than encourage their metamorphosis into land-dwelling salamanders, which are usually short-lived. On the other hand, axolotls themselves may live on average for a decade or even longer.

Plants can be included in the aquarium for these amphibians, buried in pots if you opt for a substrate, or weighed down on the floor otherwise. These will be important for breeding

Axolotls will hunt for food in their quarters.



Gravel can be hazardous to axolotl, as they may inadvertently ingest it.

## DID YOU KNOW?

The *Animal Crossing* video game series incorporated an axolotl character known as Dr Shrunk, who originally appeared in the Nintendo DS game called *Wild World*.

Anubias is the plant seen here on the left. Note the large stones being used as the substrate.

purposes, as this is where the female lays her eggs.

Java moss is especially usefully for this purpose. The choice tends to be rather restricted though, as any plants selected must be able to grow in cold water, at a relatively low light intensity. The other option, which is better suited to a non-breeding set-up, will be the use of plastic plants.

## Care in hot weather

Axolotls are very vulnerable to heat stress in the summer. It is therefore important to use a digital thermometer on their tank so that you can monitor the water conditions within, bearing in mind that as the temperature rises, so the less oxygen that will be present in solution here.

Be prepared to act if the temperature gets close to 24°C (75°F), by floating a clean, frozen bottle of dechlorinated water in their quarters, and/or carrying out a partial water change, replenishing the aquarium with colder water. Axolotls tend to be most comfortable when the water temperature is in the range of 15-20°C (59-68°F).

When filling the tank, always remember to treat the water with a dechlorinator and conditioner, just as when adding water to an aquarium for fish. This will make it safe for the axolotls. The same applies when carrying out a partial water change too.

## Feeding concerns

Axolotls will not eat any plants growing in the aquarium, simply because these amphibians are predatory by nature. For many years, they used to be fed on pieces of raw meat, but this is not a good choice for several reasons. First and foremost, it will pollute the water, even if it is eaten quite rapidly after being placed in the tank. This makes cleaning much more difficult, quite apart from making the water smell unpleasant.

In addition, there is the risk of introducing harmful microbes present on raw meat into the tank, where they could multiply. Furthermore, mince does not provide a balanced diet, being deficient in various key nutrients, most notably calcium which is essential for a healthy skeleton.

People would use a blunt cocktail stick, attaching a piece of meat to it, and then waving this around in front of the axolotl's head, so as to encourage it to strike quickly and take the meat. A dusting of grated cuttlefish bone (as sold for pet birds) was used to supplement the shortage of calcium in this type of food.

Then as the keeping of reptiles and amphibians started to become popular, and live food in the form of insects started to be widely available, so these were offered. Earthworms are a particular favourite of axolotls, and can be obtained from such suppliers, being free of parasites or toxins of any kind. Supplied in a tub, they can be rinsed off using a little tank water first, before being fed to the amphibian using blunt-ended tweezers.

Earthworms and live foods in general do not offer a balanced diet though, and many people do not want

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**BELOW** A wild type axolotl. Note the large stones being used to form the substrate. used as the substrate.

A tank with no substrate is easiest to keep clean.

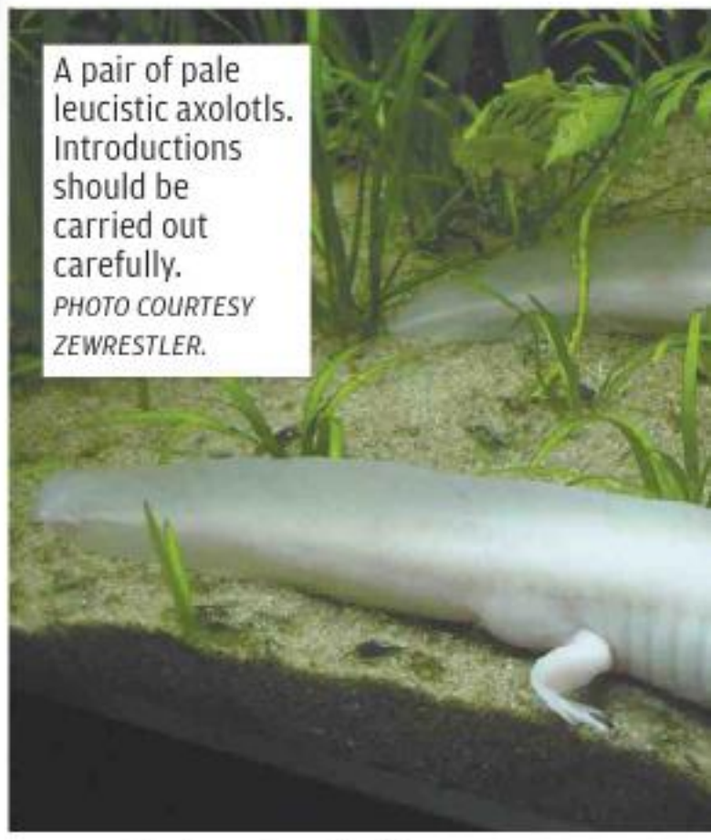
to feed their pet on this type of food. Over recent years, reflecting the axolotl's popularity, a new type of food has been marketed which overcomes these problems.

This is in the form of specially formulated pellets, that simply need to be tipped into the water, and the axolotl will take these almost immediately. They actually find their food mainly by scent. There are four sizes of pellets, suitable for axolotls measuring about 4cm (1.75in) upwards. While these are designed not to break down and discolour the water, try to match the amount of pellets that you are offering with the number that will be eaten by your pet within a few minutes.

Feeding axolotls little and often is the best guide, in accordance with the recommended feeding instructions on the brand of pellets that you have chosen. This will save wastage of food, and also reduces the risk of polluting the water. Feeding axolotls on pellets ensures that they will be receiving a balanced diet, comprised of key nutrients to keep them in good health. This can be supplemented with other items, such as Tetra's bloodworms in jelly, which can be fed straight from the packet.

## Colour variants

The normal 'wild' colouration of the axolotl is a dark sooty-brown, with some blacker spots and blotches evident on its body. Nevertheless, domestication has now led to the appearance of various colour mutations, of which the albino form is most widespread. In this case, the entire body is whitish, with the prominent feathery gills behind the head being crimson. This colouration results from the passage of blood through this part of the body, allowing carbon dioxide to diffuse out into the water, and fresh oxygen being absorbed into the axolotl's bloodstream.



A pair of pale leucistic axolotls. Introductions should be carried out carefully. *PHOTO COURTESY ZEWRESTLER.*

More unusual colour variants seen today include pieds, with their black and white markings, as well as olive and golden-yellow individuals. There is also a much darker form than normal, known as the hypermelanistic. Scientists in North America have even created a Frankenstein form that glows neon green in colour, thanks to the input of a fluorescent jellyfish gene into its DNA.

## Breeding

Male axolotls can usually be recognised by their broader heads,

**ABOVE** Golden yellow axolotls of this type are relatively scarce, and youngsters may sell for £35 or so – about twice the cost of a normal axolotl.

## Top Tip

Do not obtain a large quantity of axolotl pellets, because these will need to be used up before the stated expiry date. Otherwise, the value of the vitamins in particular will decline, leaving the amphibians at risk of nutritional deficiencies.

and the swollen area around the vent as they mature, while female may swell with eggs at the start of the breeding season.

Each spring in their natural environment, the melting winter snow and ice lowers the water temperature in the lakes where axolotls occur, and this appears to act as a significant breeding trigger.

In the home aquarium, adding colder water to the tank, or even ice cubes, to create a temperature of around 10°C (50°F) for a fortnight or so, before allowing it to warm up again, will have the same effect. Alternatively, you may simply be able to match this effect by moving the tank to a cooler part of the home at this time of year, but check the water temperature does not dip too low.

The male will display actively towards his intended mate, in effect dancing around her, before releasing packets of sperm, known as spermatophores. The female will then pick these up with her vent, before laying a maximum of 1000 eggs, carefully anchoring them to water plants with her back legs.

Hatching should then occur about a fortnight later, with the young axolotls emerging from their eggs and measuring approximately 1cm (0.4in) in length at this stage. They are miniature replicas of the adults, except for the fact that they have no legs at this stage. These will have developed by the time they have grown to about 5cm (2in) in length.

They digest the remains of their yolk sacs at first, just like young fish, and then start swimming freely by the time they are about a week old. Powdered fish flake is a useful starter food, as well as live daphnia, but as the young axolotls start to grow older, so they start to hunt other aquatic creatures such as worms of various types.

As they become larger, so they must be given more space, because otherwise, they are likely to end up injuring each other, by biting at their limbs. Be prepared to divide them up into smaller groups of similar size. By their first winter, the young axolotls will have grown to about 15cm (6in) long, and they may even start breeding during the following year.

**ABOVE** A young axolotl being moved on a plastic spoon. *PHOTO COURTESY KORI MATIESSA.*

The feathery gills and blood passing through them can be seen clearly here.

### One or two?

Axolotls are often rather aggressive towards each other, and are best kept apart, unless their quarters are spacious. If you acquire a pair as youngsters though, they may grow up and live in harmony, particularly if you can divide their tank up with underwater features such as bogwood.

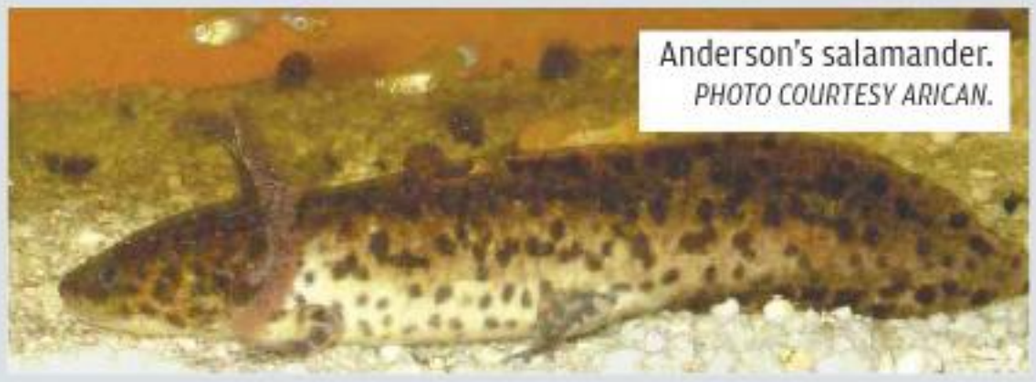
It also helps to try to feed them separately in different areas of the tank, and supervise feeding closely. In its desire to grab food, so an axolotl may seize one of the legs of its companion, potentially severing the limb in its strong jaws.

This is when another remarkable characteristic of these amphibians becomes apparent, which has been the subject of intense scientific study over many years. Instead of being crippled by the loss of a leg, the injured axolotl will then grow a replacement instead, over the course of some weeks. This is likely to end up being virtually indistinguishable from its original limb.

Only very rarely, in the case of a weakened axolotl, will a wound of this type become infected with fungus. This will appear as a slight halo around the site of the injury, and if treated with a proprietary remedy, there is still every chance that the axolotl will make a full recovery.

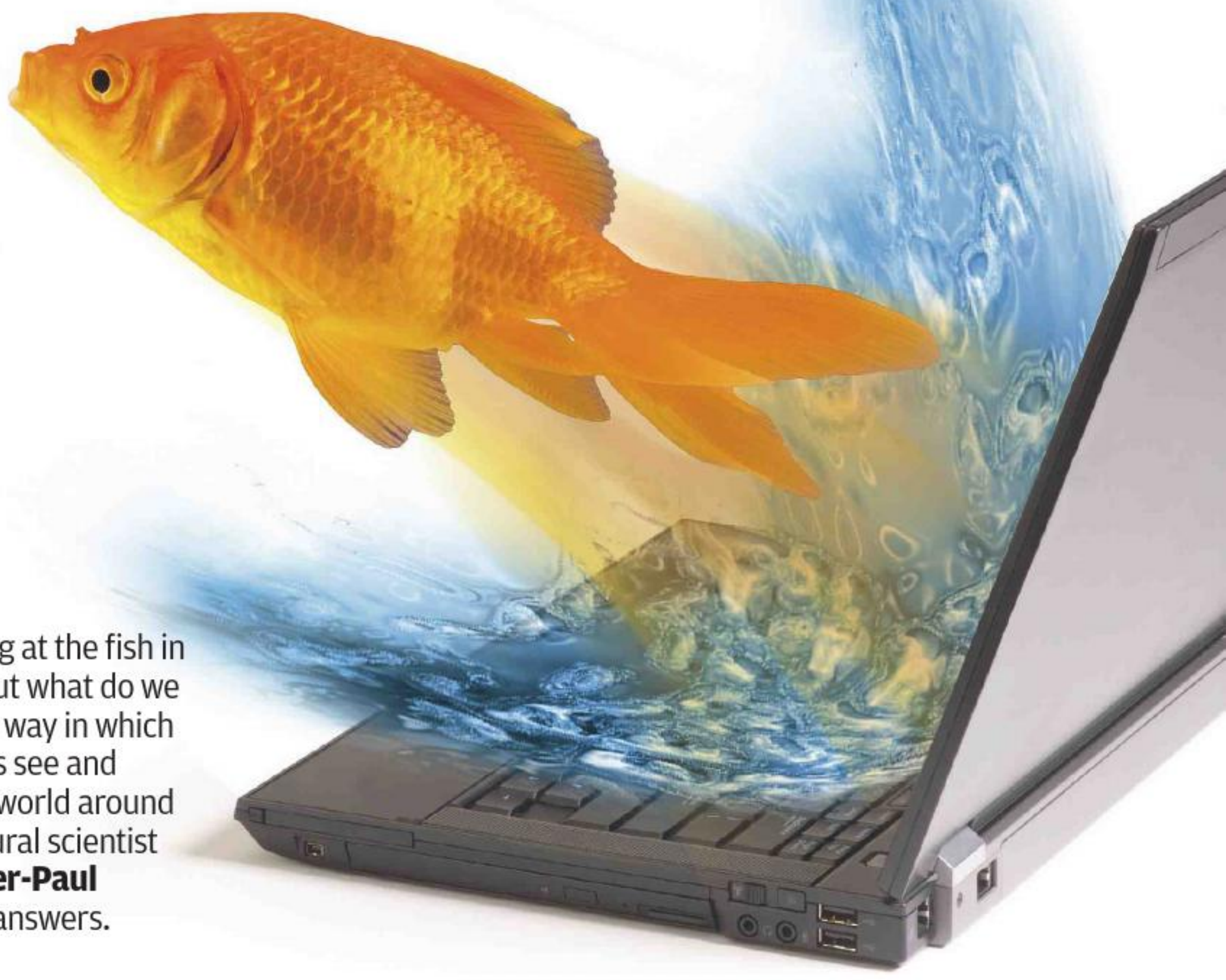
### Did you know?

Although the axolotl is the best-known member of this group of salamanders displaying neoteny, it is not the only example of its type. Anderson's salamander (*Ambystoma andersoni*) has a very similar lifecycle, and originates from Laguna de Zacapú in the Mexican state of Michoacán, where it was only discovered as recently as 1984. It has since been bred repeatedly in Europe, and is easily distinguishable from its relative by its reddish-brown ground colour, on which a series of black blotches and spots are superimposed. Their care needs are basically identical.



Anderson's salamander. *PHOTO COURTESY ARICAN.*

# A fish's powers of memory



We enjoy looking at the fish in an aquarium, but what do we know about the way in which they themselves see and experience the world around them? Behavioural scientist **Dr Julia Mueller-Paul** provides some answers.

The early finding that suggesting that goldfish have a memory span of no more than three seconds has really set back studies of fish intelligence, and yet it is interesting how this supposed 'fact' has entered mainstream consciousness. If nothing else, it shows just how people are actually quite interested in such research!

I guess is partly a reflection that at some point in their lives, almost everyone will have kept or had direct contact with a goldfish. Unfortunately, on the other hand, fish - and especially goldfish – have acquired a reputation for having a poor memory and very limited intelligence. Is this a fair summary of their abilities though?.

## Common links with birds and mammals

Cognition is the term used to describe mental capabilities such as memory, attention, and understanding of the world around us. Fish cognition is not the most widely studied of topics but research gives us a fascinating insight into their often surprisingly well-developed abilities.

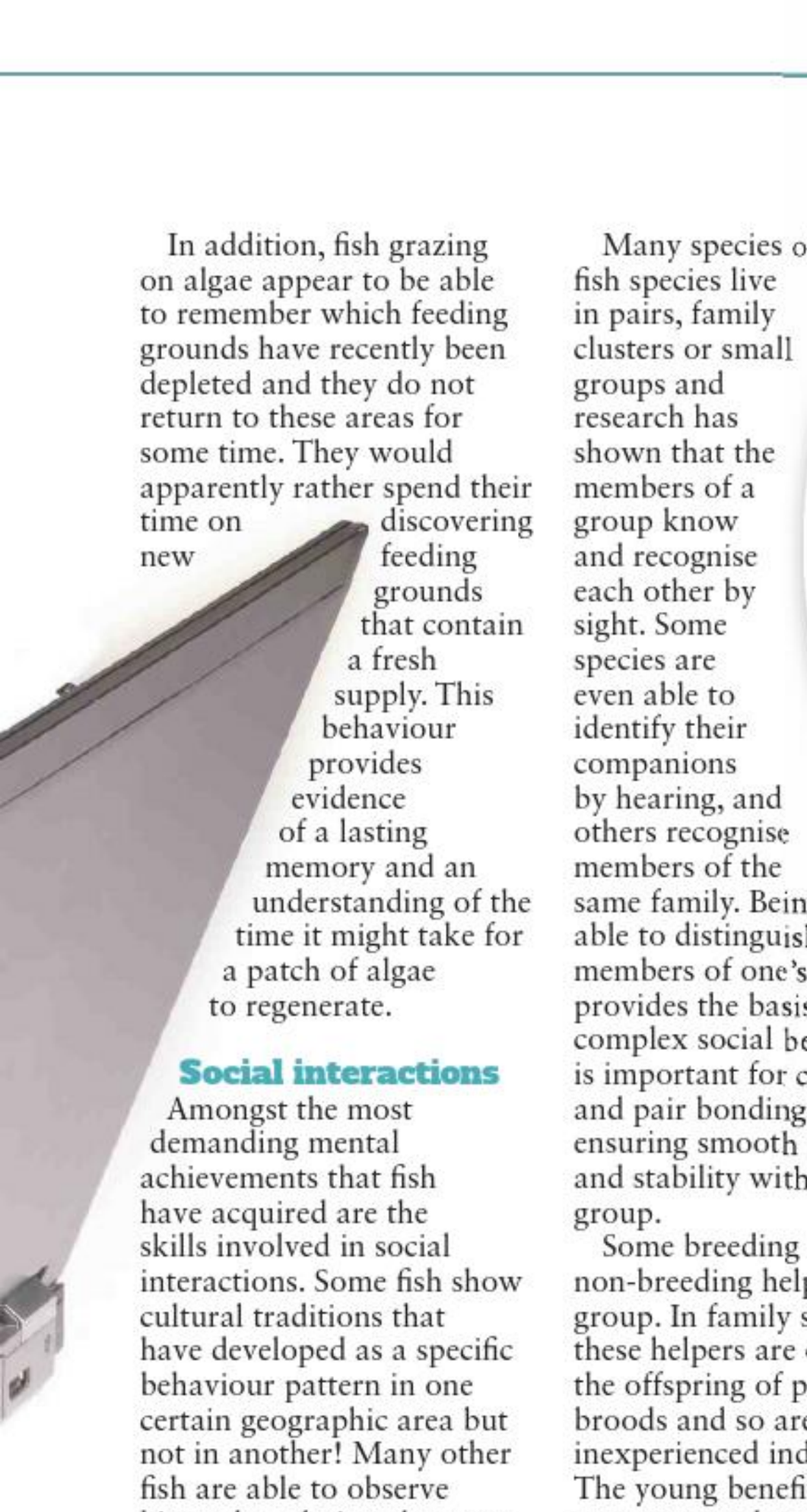
In addition, more modern studies have in fact come to conclusions that are quite different from those well-known early findings. The suggestion now is that the memory span of many fish is actually comparable to that of most other vertebrates. Their cognitive abilities can be very complex and in some cases, resemble those of non-human primates.

Recent research might have revealed one of the reasons for the similarities between the cognitive abilities of fish and those of mammals and birds. A part of the brain called the cerebellum is involved in the processing of cognition in all of these vertebrate groups. This suggests that the evolutionary roots of cognition and its processing centres in the brain were established at a very early stage in the evolutionary development of vertebrates, so forming a common basis for the processing of complex behaviours.

Cognitive abilities apply to a variety of different areas of life such as finding food, avoiding predators and danger, orientation, and social interactions. Finding food is of major importance to all animals of course, and in some cases, intricate skills have been developed by fish to ensure a ready supply of all the nutrients needed.

## What feeding behaviour reveals

Fish are, for example, able to assess the quality of a feeding ground. If an area is valuable because it contains a lot of prey, they remain there for longer, even after catching sufficient prey for their immediate needs. This shows that fish are able to adjust their behaviour to local environmental conditions and also remember which locations are more favourable than others.



In addition, fish grazing on algae appear to be able to remember which feeding grounds have recently been depleted and they do not return to these areas for some time. They would apparently rather spend their time on discovering new feeding grounds that contain a fresh supply. This behaviour provides evidence of a lasting memory and an understanding of the time it might take for a patch of algae to regenerate.

## Social interactions

Amongst the most demanding mental achievements that fish have acquired are the skills involved in social interactions. Some fish show cultural traditions that have developed as a specific behaviour pattern in one certain geographic area but not in another! Many other fish are able to observe hierarchy relations between members of their social group and to cooperate in various ways. Other complex social strategies involve deception, manipulation, and reconciliation.

Many species of fish species live in pairs, family clusters or small groups and research has shown that the members of a group know and recognise each other by sight. Some species are even able to identify their companions by hearing, and others recognise members of the same family. Being able to distinguish members of one's group provides the basis for complex social behaviour. It is important for cooperation and pair bonding, as well as ensuring smooth interactions and stability within the group.

Some breeding fish accept non-breeding helpers in their group. In family situations, these helpers are often the offspring of previous broods and so are young, inexperienced individuals. The young benefit from the arrangement because the group provides safety, as well as by being given the opportunity to learn about brood care from the older, more experienced fish. The older fish benefit from help with brood protection.

Members of a shoal of fish can recognise each other.

However, sometimes the helpers make attempts to mate within their group, which is a risky strategy as it might lead to their eviction. In order to avoid such a fate, the submissive fish commonly show appeasement behaviour towards their elders.

In the cichlid *Tropheus moorei*, a clear correlation was found between the rank of an individual and the frequency with which it showed appeasement behaviour.

This form of behaviour is very complex and closely resembles the behaviour found within primate groups, which gives an indication of the extent of the cognitive abilities found in these fish.

## Staying safe

Another fascinating behaviour is called predator inspection. This means that a couple or small group of fish leave the safety of their shoal to approach a predator and assess at closer range how much danger it might pose to the group. Such behaviour is found in many shoaling fish including Guppies. When on a predator inspection, much depends on the interactions between the members of the exploring party.

If one fish decides to cheat and return to safety before its companion, its partner will be left exposed in great danger. Studies have revealed that fish do not forget such treachery. In contrast, on future occasions they are much more likely to cheat on fish that have cheated on them previously.

Also, fish are much bolder and more confident in this situation when going on an inspection with a partner

Fish are adept at finding and utilising food sources, without wasting energy.

CONTINUES ON THE NEXT PAGE »

who has a history of good cooperation and can be trusted. Guppies are able to remember their experiences with many other fish and act accordingly in future interactions.

## Using their knowledge

This is not the only way in which fish cooperate though. Several species have been shown to hunt in groups, with the different members of the group then taking on different roles. The strategies used by a group can also be varied, depending on the species of prey they are about to hunt. Other species, such as Guppies, can learn the way to a promising feeding ground from more experienced fish in their vicinity.

In groups, gathering information about others can be very useful, and female Guppies are known to change their mind about a mating partner when they observe that partner courting another female. Similarly, Siamese fighting fish (*Betta splendens*) are more vigorous in fights with opponents they have previously seen lose to another fish than those they have observed winning.

Snail (*N. multifasciatus*) and dwarf cichlid (*Apistogramma trifasciatum*) females chase away unfamiliar females that try to enter their group. The males, however, benefit from a larger number of females in their group. So if a male sees such aggression between females he will often intervene in favour of the unfamiliar female and aid her incorporation into the group.

All these behaviours show that fish not only know their companions but that they are able to observe and understand their behaviour, and also the consequences that this behaviour has on themselves. They can then use the information they have gathered by close observation and adjust their behaviour to act in a way most beneficial to themselves.

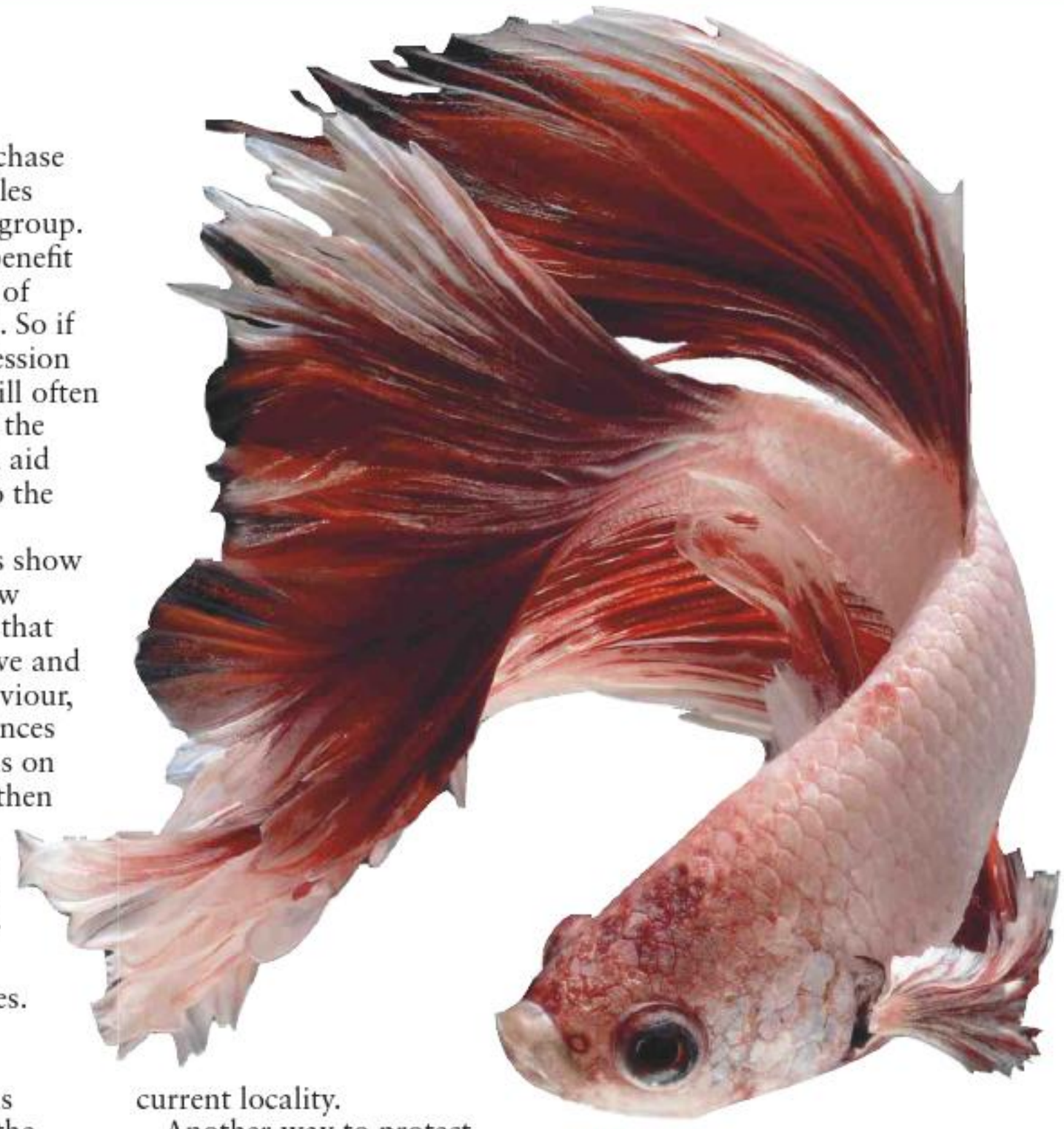
## Tool use

A cognitive skill that is ranked very highly is the use of tools that the animal chooses and handles itself. South American cichlids are able to use tools. Banded acara (*Bujurquina vittata / Aequidens paraguayensis*) convert plant leaves into carrying trays for their eggs and use these to move their eggs to safety when the parent fish feel their offspring might be in danger in their current locality.

Another way to protect their spawn or themselves is to build nests. These are often very complex and require not only building skills but also cognitive skills. Some fish collect stones of exactly the right size and shape to be fitted as entrance doors to their burrows that just about allow for them to enter and leave.

Such stones are not necessarily found in the immediate vicinity of the burrow. Finding them often requires the fish to search at a distance while keeping the dimensions and requirements of the desired stone in mind. Such behaviour demonstrates not only powers of memory but also a certain kind of planning information, intention and geometric knowledge.

In order to safely navigate to and from their nests and burrows, fish can use landmarks. That is, they remember a number of outstanding structures near their home to find their way back from a distance. This type of memory can remain after a six months absence from a location, so that fish can find their way home even when they have not seen the area for a long time.



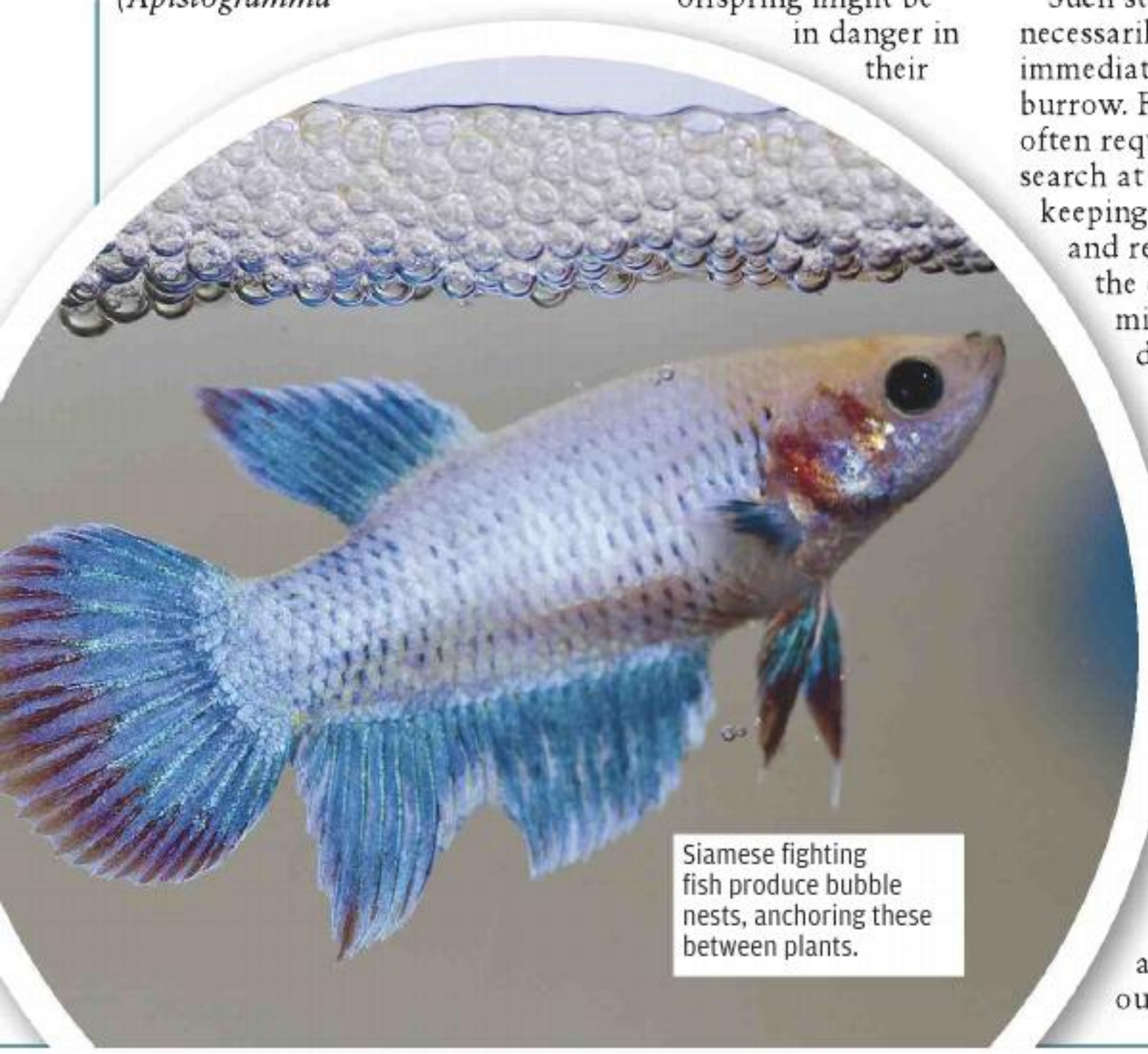
**ABOVE** Male bettas can remember and recognise an opponent's weakness.

## Welfare implications

All these findings reveal that fish have the ability to think and remember. In fact, their cognitive abilities are quite comparable to those found in mammals and birds. Therefore, the importance of welfare standards in fish care should never be underestimated.

Neglect and ill treatment is not forgotten within three seconds as might have been thought once upon a time, but has a great effect on the welfare of this often-underestimated group of animals. Stimulating, enriched, species-appropriate environments are just as important for the well being of fish as they are for that of mammals and birds.

● *To be continued in our next issue.*



Siamese fighting fish produce bubble nests, anchoring these between plants.

# Puzzle page

See if you can solve the puzzles here! You can find all the answers on page 82.

## SICK LIST

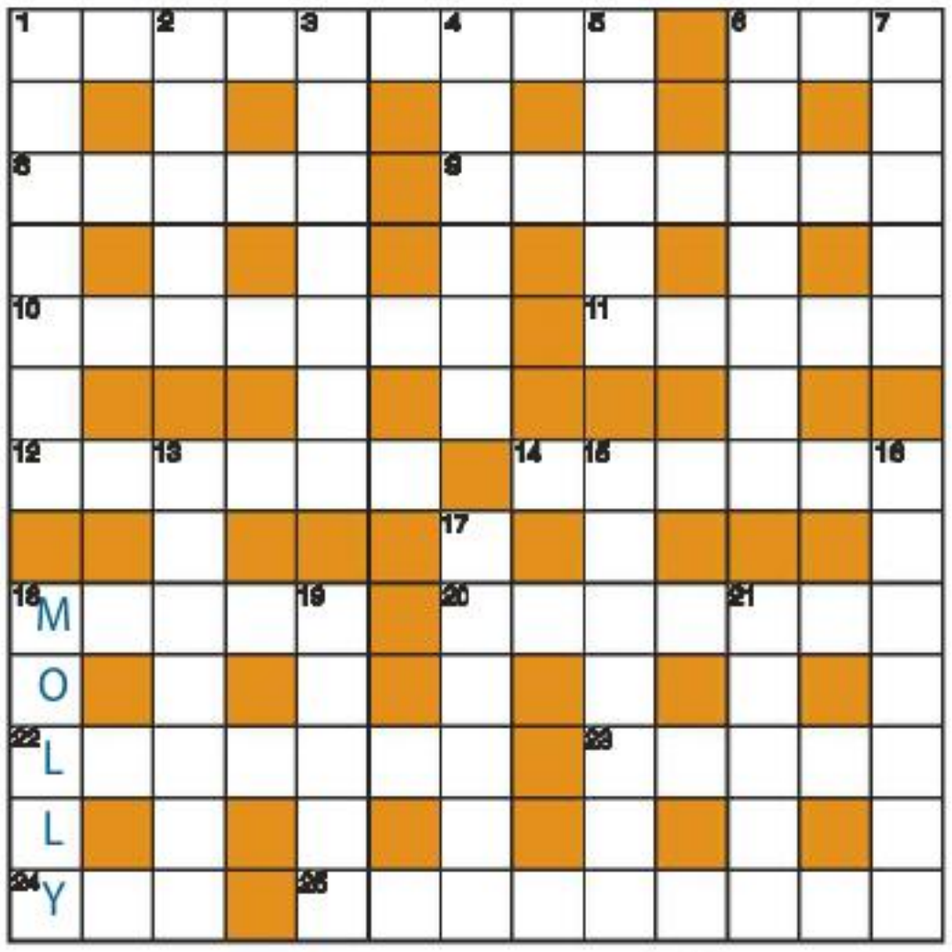
**An unlucky thirteen of the listed pests and diseases affecting aquarium fish have been hidden - up, down, diagonally, back and forth - in the grid. Which one is missing and which is deliberately mis-spelt?**

ANCHOR WORMS, COTTON MOUTH, DROPSY, FIN ROT, FLUKES, FUNGUS, HEXAMITA, LYMPHOCITIS, MYXOBACTERIOSIS, OODINIUM, PEST SNAILS, SEPTICEMIA, TETRAHYMENA, WHITE SPOT.

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

## 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 - MOLLY.**




**ACROSS**

**1** Listless, lacking in vitality (9)
**6** Intestine (3)
**8** * * * * * (5)
**9** * * * * * * * (7)
**10** Flat fruit bun (7)
**11** Surprise, stun (5)
**12** Dwell, have one's home (6)
**14** Portrayed, acted out the role of (6)
**18** Female house-servants (5)
**20** Pupil's shoulder bag (7)
**22** Space rocket's moment of launch (4-3)
**23** 'Doctor fish' (5)
**24** Unit of Japanese currency (4)
**25** Popular spotted breed of dog (9)

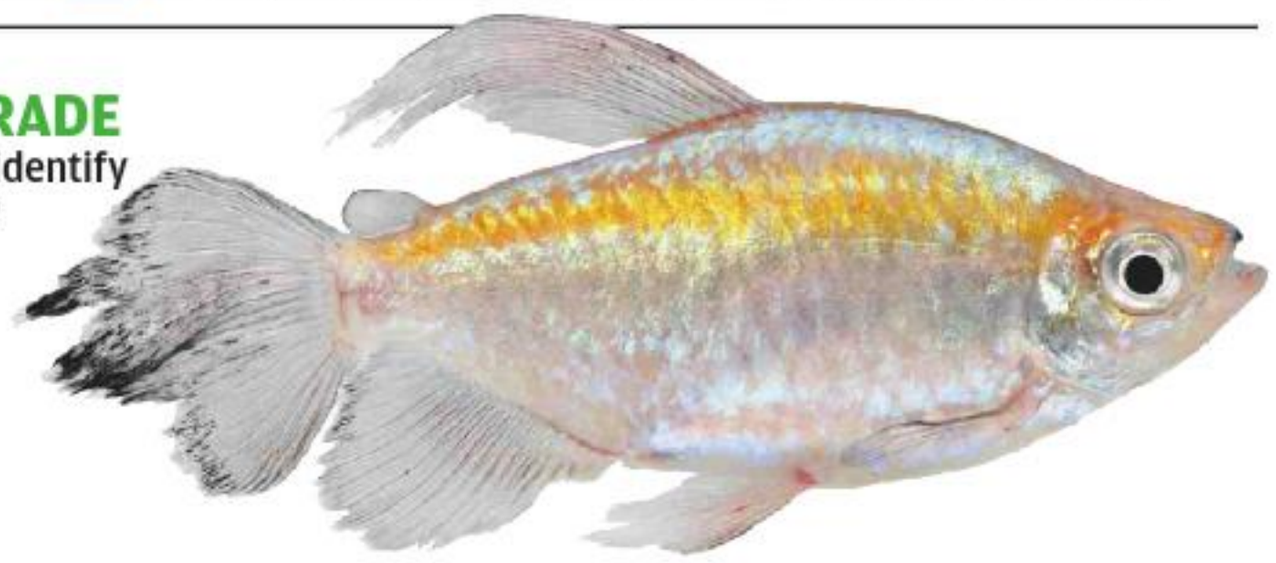
**DOWN**

**1** Large edible marine crustacean (7)
**2** Bejewelled head band (5)
**3** Clumsy, without poise or elegance (7)
**4** Sportsman playing 18 holes (6)
**5** Hooded venomous snake (5)
**6** Homeland of Boris Becker (7)
**7** Parsley, sage, rosemary and - - - (5)
**13** * * * * * * * (7)
**15** - - - Dean, EastEnders actress (7)
**16** Porpoise-like marine mammal (7)
**17** Handy, of service (6)
**18** MOLLY
**19** Fencing weapon (5)
**21** Asian language (5)



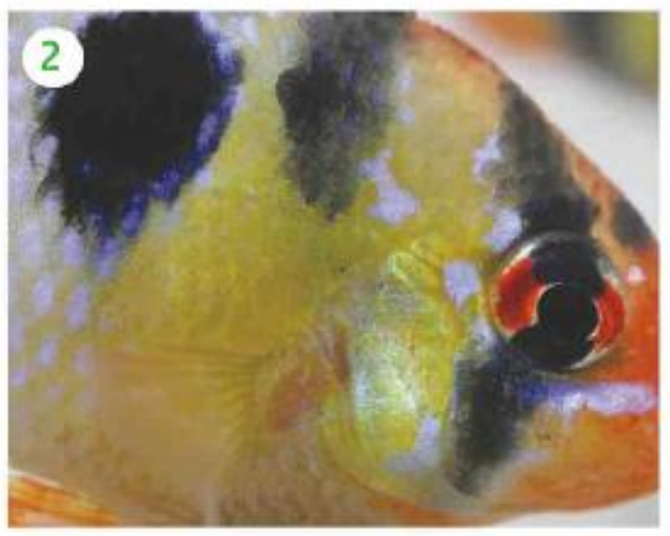
## ID PARADE

**Can you identify this fish?**

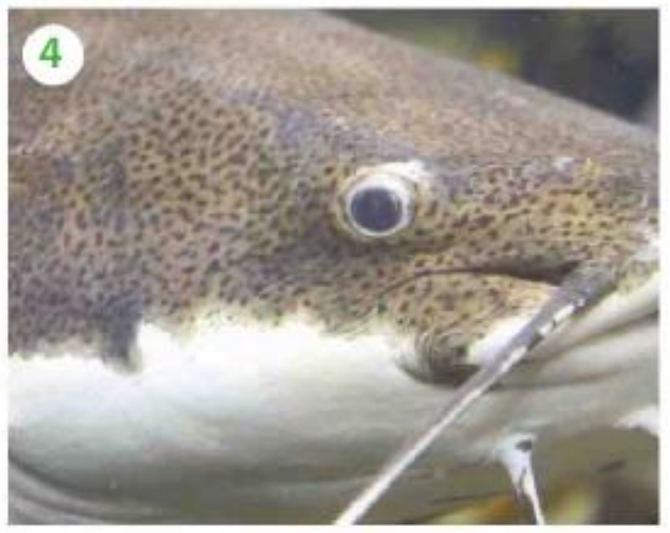


## WHICH FISH IS THIS?

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

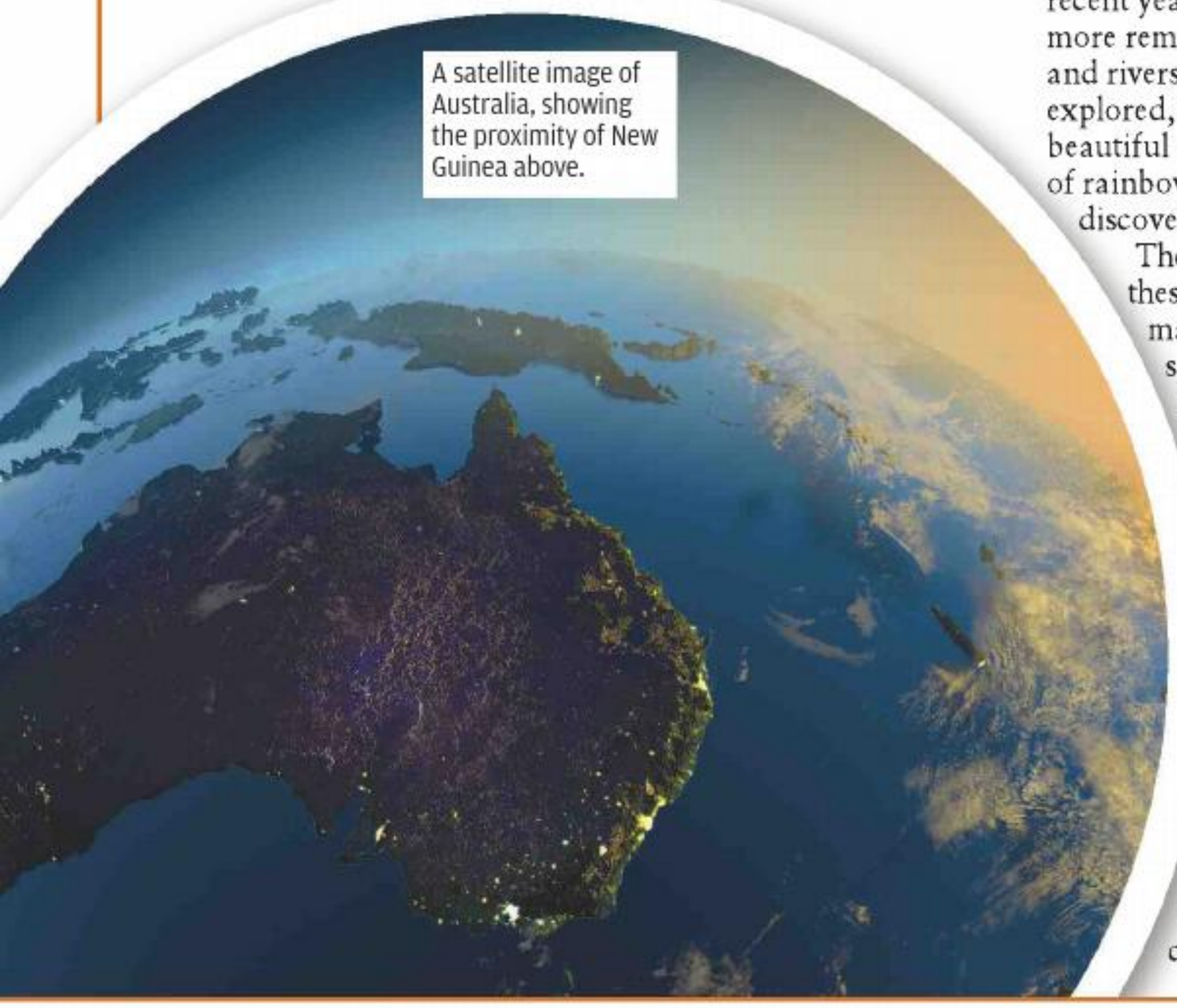





Red rainbowfish. *PHOTO COPYRIGHT PHOTOMAX AT THE GOLDFISH BOWL, OXFORD*

# The world of rainbowfish

Whereas some groups of fish have been well-known now for centuries, and have been popular aquarium favourites for many years, there are still some that are relative newcomers in the hobby – and prominent amongst these are the beautifully coloured rainbowfish, as **Don Harper** reports.



A satellite image of Australia, showing the proximity of New Guinea above.

While rainbowfish occurring in northern and eastern parts of Australia have been reasonably well-documented for some time now, it is those found on New Guinea and neighbouring islands that have excited both ichthyologists and fish breeders alike over recent years. As some of the more remote areas of lakes and rivers there have been explored, so often stunningly beautiful and localised forms of rainbowfish have been discovered.

The adaptability of these fish is such that many of these new species are now being widely bred in aquariums in many countries around the world. Rainbowfish in general tend to be quite suitable for community set-ups, although they need to be kept in shoals. Otherwise, they can prove to be quite nervous, and this can distress their companions as well.

## 1. Red rainbowfish (*Glossolepsis incisus*)

**Grows to:** 15cm (6in)

**Water chemistry:** neutral-alkaline (pH 7-8) and hard

**Water temperature:** 25-30°C (77-86°F)

There is a marked difference in appearance between males of this species, which are a reddish shade with silvery speckling, and females, with their yellowish colouration and associated olive-green hues. Young fish of both sexes resemble adult females, up until the stage when they are about 5cm (2in) long. Males are transformed not just in colour at this stage, but also their profile alters, and they acquire their characteristic high-backed appearance.

This species is confined to Lake Sentai in the northern part of New Guinea. Being active fish by nature, and relatively large in size, so a group will require a spacious tank. Spawning is a protracted process, and takes place over several weeks, with a female laying 100-150 eggs in total.

Boeseman's rainbowfish.

Boeseman's rainbowfish in close-up.

These are likely to take up to 10 days to hatch. Remove the eggs as they are laid, and place these in a separate tank where the young can be reared.

PHOTO COPYRIGHT PHOTOMAX AT THE GOLDFISH BOWL, OXFORD

## 2. Sepik rainbowfish (*Glossolepis multisquamata*)

**Grows to:** 14cm (5.5in)
**Water chemistry:** acidic (pH 6.5) and soft
**Water temperature:** 24-27°C (75-81°F)

These attractive-coloured rainbowfish favour slow-flowing waters, and were first documented by a Dutch explorer called W.C. van Heurn back in 1920. They were discovered in the little-known Mamberamo river system, in northern West Papua.

There has been considerable confusion over recent years about the identity of Sepik rainbowfish. However, it is now clear that those obtained by Heiko Bleher in 1992 match those found by van Heurn. These particular rainbowfish were known for a time as red-eyed tiger rainbowfish in Australia, but simply described as *Glossolepis sp.* (Mamberamo) in Europe, until their true identity was confirmed. As with other members of this genus, both sexes have quite broad bodies.

## 3. Threadfin rainbowfish (*Iriatherina werneri*)

**Grows to:** 5cm (2in)
**Water chemistry:** acidic to alkaline (pH 6.5-7.5) and soft
**Water temperature:** 22-29°C (72-84°F)

The elaborate fins that distinguish males of this small species of rainbowfish are used to good effect during courtship. They are raised and then flicked up and down, to catch the female's eye. There are localised variations in fin colouration that may still be apparent in domesticated strains, with those having yellow dorsal fins being typical of wild populations occurring in the state of Queensland.

Their distribution extends from northern Australia up to New Guinea, where the species can be encountered in the area between the Fly and Merauke rivers. Those found in New Guinea tend to be a darker shade than those from Australia.

One of the characteristics of rainbowfish is very apparent in this species, namely the split dorsal fin. Instead of possessing a single dorsal fin on the back, like most fish, members of this group have what has effectively become two separate fins, with a short gap between them.

Like other rainbowfish, the threadfin is easy to cater for – although these fish prefer to eat small livefoods, they will take flake food too. Egg-laying takes place over the course of several days, with rotifers making an ideal rearing food for the tiny young.

## 4. Boeseman's rainbowfish (*Melanotaenia boesemani*)

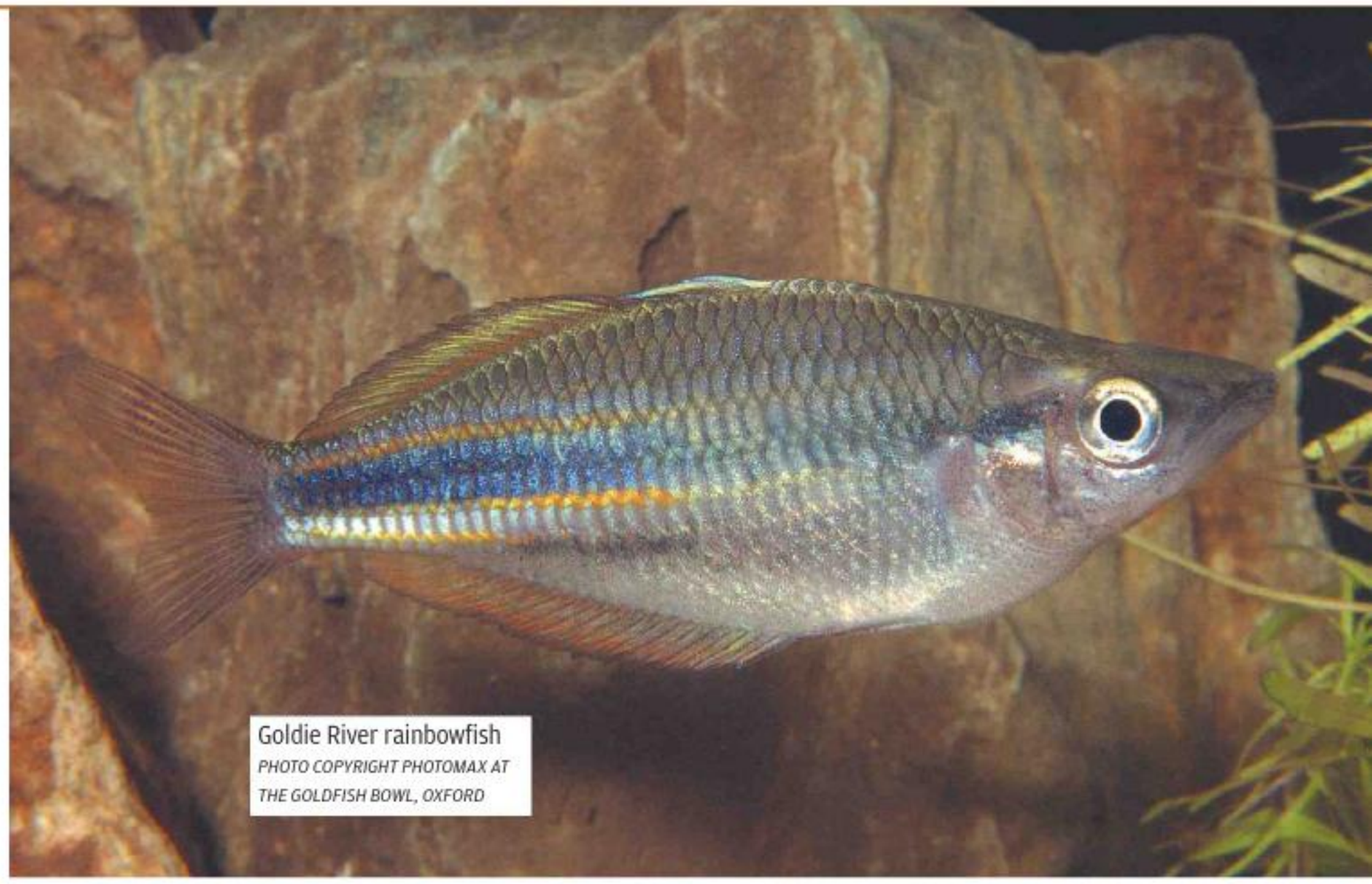
**Grows to:** 12cm (4.75in)
**Water chemistry:** acid-alkaline (pH 6.5-8.0) and soft
**Water temperature:** 25-30°C (77-86°F)

This particular species is currently one of the most widely kept members of the group. It was first discovered by Dr Marinus Boeseman, who took part in a Dutch expedition to New Guinea in 1954, and was found again during 1982. It was then that some specimens

TURN OVER FOR MORE FISH OF THE WORLD »

were sent to Europe by Heiko Bleher (whose name is commemorated in the related Bleher's rainbowfish - *Chilatherina bleheri*), and since then, they have been bred on numerous occasions. Females produce between 100-200 eggs at a typical spawning.

The sexes are fairly similar in colouration, but you can identify the males by their deeper bodies, and they also have longer rays on their dorsal fins. There is some variance between different strains, as the rear yellowish-orange part of the body is of a slightly redder shade in some instances. These fish do make an attractive sight, swimming in shoals in an aquarium combining both well-planted areas with more open stretches of water.



Goldie River rainbowfish
*PHOTO COPYRIGHT PHOTOMAX AT THE GOLDFISH BOWL, OXFORD*

*PHOTO COPYRIGHT PHOTOMAX AT THE GOLDFISH BOWL, OXFORD*

## 5. Lake Tebera rainbowfish (*Melanotaenia herbertaxelrodi*)

**Grows to:** 13cm (5in)
**Water chemistry:** alkaline (pH 7.5) and hard
**Water temperature:** 24-27°C (75-81°F)

Named after the well-known American aquarist and ichthyologist, Dr Herbert Axelrod, this particular rainbowfish occurs in the central highlands of New Guinea, close to Lake Tebera that forms part of the Purari river system. As in other members of this genus, mature males can be distinguished by their deeper body profile.

The middle section of the first part of the male's dorsal fin is also longer, compared with that of the female. But it is at the start of the spawning period that the appearance of males change, with the emergence of a blue or white stripe extending from the dorsal fin down over the head.

Peaceful by nature, these rainbowfish again require a well-planted tank, to provide them with a sense of security, with open areas where they can swim. When spawning, females may produce clutches of around 150 eggs. These are likely to take about 10 days to hatch.

## 6. New Guinea rainbowfish (*Melanotaenia affinis*)

**Grows to:** 14cm (5.5in)
**Water chemistry:** Neutral (pH 7.0) and hard
**Water temperature:** 21-28°C (75-81°F)

Three different strains of this rainbowfish have been recognised, based on their area of origin in northern parts of New Guinea. The so-called 'standard' has the widest distribution, and is the most commonly available form in the hobby. The Pagwi variety occurs in a single tributary of the Sepik river, as far as is known, while Madang is home to the Blue Water Creek form.

This species was one of the first rainbowfish to become available to fish keepers. Males in all cases are quite easy to recognise, thanks to their more colourful appearance, combined with their more elaborate dorsal and anal fins. They also tend to grow slightly larger overall than females.

It is important to keep different strains separate though, rather than cross-breeding, bearing in mind that a number of rainbowfish will hybridise quite readily. As a result, it is recommended not to mix different rainbowfish together in the same tank in any event.

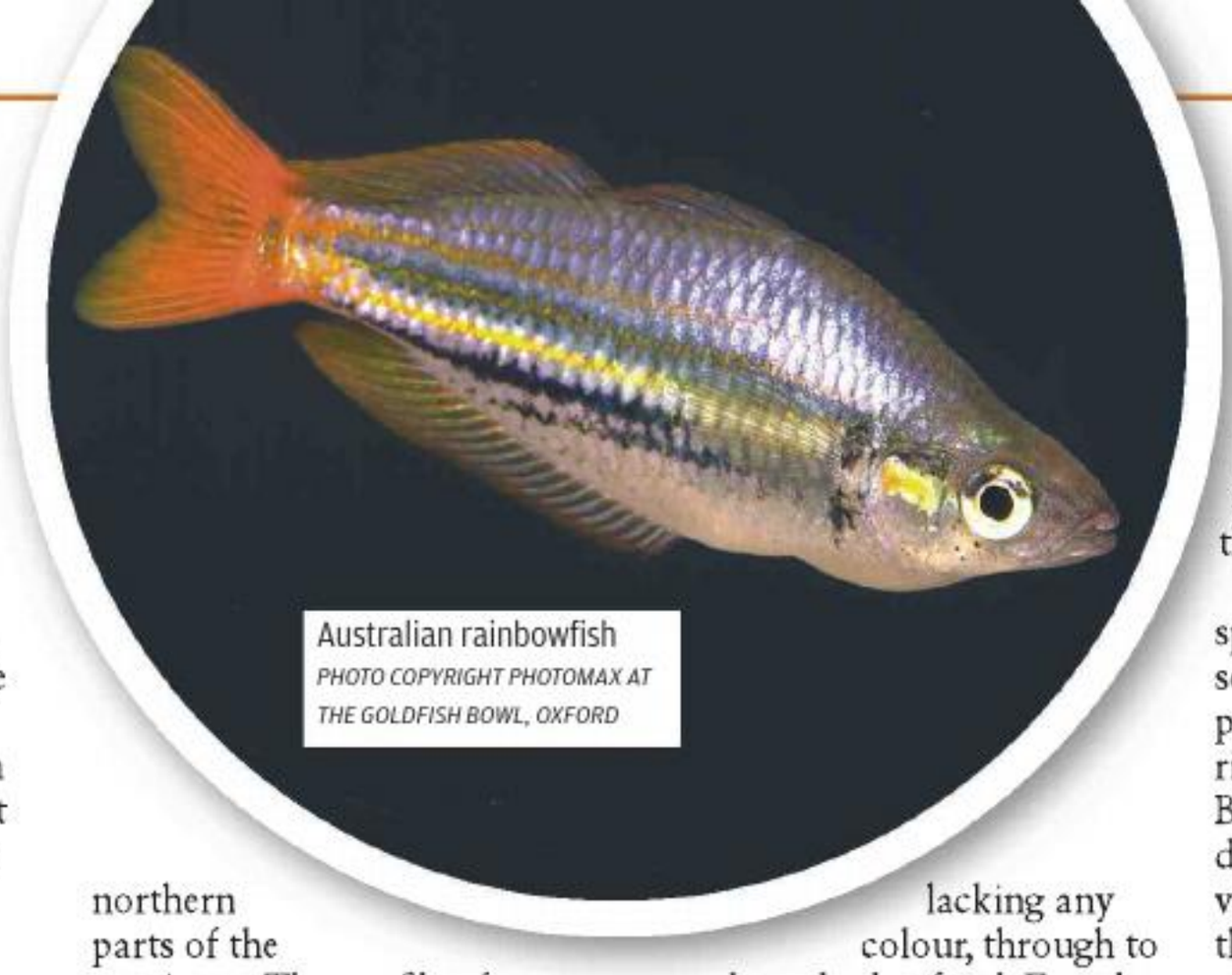
The care of New Guinea rainbowfish does not different significantly from other members of the group. They are easy to cater for, eating both prepared foods as well as small live foods, which can serve as a conditioner for breeding purposes.

## 7. Goldie River rainbowfish (*Melanotaenia goldei*)

**Grows to:** 10cm (4in)
**Water chemistry:** neutral-alkaline (pH 7.0-7.8) and hard
**Water temperature:** 24-30°C (75-86°F)

This species is named after a tributary of New Guinea's Laloki River, in the southern part of the country, close to the capital Port Moresby. It

New Guinea rainbowfish
*PHOTO COPYRIGHT PHOTOMAX AT THE GOLDFISH BOWL, OXFORD*



Australian rainbowfish
*PHOTO COPYRIGHT PHOTOMAX AT THE GOLDFISH BOWL, OXFORD*

was first described back in 1883, and since then, it has become clear that it is one of the most widely distributed rainbowfish in the southern part of the country.

Goldie River rainbowfish can be found in a wide range of habitats, although they tend to be most numerous in relatively slow-flowing forest streams. Their habitat alters significant through the year though, and so they quite adaptable in terms of water chemistry, as well as water temperature too. Secluded lighting, with the addition of flowing plants, brings out the subtleties of their colouration in aquarium surroundings.

They are not particular common in the aquarium hobby at present, although they were first kept over 50 years ago. Goldie River rainbowfish tended to be overlooked when other species started to become available. The so-called 'Tapini' strain that is offered today is descended from stock collected at the end of the 1980s by Heiko Bleher, from the Loloipa River. Their range actually extends much further than was previously thought though, with a population even present on the Aru Islands.

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## 8. Black-banded rainbowfish (*Melanotaenia nigrans*)

**Grows to:** 12cm (4.75in)
**Water chemistry:** acid-alkaline (pH 5.0-8.1) and soft
**Water temperature:** 22-30°C (72-86°F)

This was the first member of the genus to be discovered, collected from the King River in Australia's Northern Territory back in 1840. It is now clear that there are a number of different populations, found across northern parts of the continent. The profile of the black-banded rainbowfish is more slender than that of many of its relatives, and it also tends to be slightly larger.

These rainbowfish are highly adaptable, both in terms of their feeding and breeding habits. They will eat a wide variety of invertebrates as well as algae in the wild, and are equally opportunistic in terms of their feeding habits in aquarium surroundings too.

Black-banded rainbowfish will breed through the year in the wild, with females tending to produce small numbers of eggs on a regular basis. A single spawning may give rise to 50 or so eggs.

## 9. Australian rainbowfish (*Melanotaenia australis*)

**Grows to:** 10cm (4in)
**Water chemistry:** acid-alkaline (pH 6.5-8.0) and hard
**Water temperature:** 22-30°C (72-86°F)

Sometimes described as the western rainbowfish, as it originates from north-western parts of Australia, this species used to be included as part of the *Melanotaenia splendida* complex, but recent genetic studies have confirmed that it is actually a distinct species in its own right. Its appearance is quite variable, reflecting the fact that it is found over a wide area, and probably is the most common species in the wild there. Furthermore, it now appears that the two separated populations themselves are two distinct species.

Their fins can vary from being almost transparent, lacking any colour, through to a deep shade of red. Females in general are much paler in colour than males overall, and also have shorter dorsal fins. Males do not display a band of colour, extending from the top of the mouth to the dorsal fin, as seen in some other species, nor is the difference in fin length between the sexes as marked either.

The eggs, numbering between 100-200 per spawning, attach to vegetation by fine threads, and hatch within 10 days. The young develop quite quickly, and will have reached around 2.5cm (1in) in length by three months old.

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## 10. Irian Jaya rainbowfish (*Melanotaenia irianjaya*)

**Grows to:** 12cm (4.75in)
**Water chemistry:** Alkaline (pH 7.3-7.8) and hard
**Water temperature:** 24-27°C (75-81°F)

This is one of the less-commonly available species, first described officially in 1985, although it was originally discovered by Heiko Bleher three years earlier, and entered the aquarium hobby during the following year. As with many other rainbowfish, males are brighter in colour, and they also grow to a larger size than females.

The habitat where this species is found in the southern part of the Vogelkop peninsula, mainly in the river systems that flow into Bintuni Bay, is somewhat different. There is little aquatic vegetation in the water, and these rainbowfish tend to congregate around logs that provide them with cover. Similar décor in the aquarium will suit them well, with bogwood being ideal for this purpose.

## 11. Neon dwarf rainbowfish (*Melanotaenia praecox*)

**Grows to:** about 7.5cm (3in)
**Water chemistry:** acidic-alkaline (pH 6.8-7.5) and soft
**Water temperature:** 23-28°C (73-82°F)

Restricted to the Mamberamo river system in New Guinea, these fish favour the fast-flowing tributaries feeding into the river itself, as well as surrounding areas of flooded marshland, preferring to frequent areas with vegetation.

This needs to be reflected in the design of their tank, which should be quite densely planted, incorporating bogwood as well, with more open areas for swimming. A set-up of this type will enhance the natural beauty of these fish, as will a diet that features livefood, with good water quality being vital.

Males can be recognised by their brighter colouration, and they also acquire a significantly deeper body shape as they mature. A plain, bare-bottomed spawning tank can be provided, with Java moss or a spawning mops being added. The eggs are quite slow to hatch, taking a week or so, and then the tiny fry will cluster around near the surface at first.

***Further information***
See http://rainbowfish.angfaqld.org.au/Rainbowfish.htm

# Next issue

**JAN/FEB ISSUE ON SALE FRIDAY 20TH DEC**

## Malawi cichlids

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

## The Fish Doctor

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

## 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 Cockatoo dwarf cichlid (*Apistogramma cacatuoides*) 2. Ram cichlid (*Apistogramma* (*Mikrogeophagus*) *ramirezi*) 3. Lemon tetra (*Hyphessobrycon pulchripinnis*) 4. Red-tailed catfish (*Phractocephalus hemioliopterus*) 5. Rummynose or firehead tetra (*Hemigrammus bleheri*)

**PUZZLE IT OUT SOLUTION**

**Across:** 1 Lethargic, 6 Gut, 8 Black, 9 Liberty, 10 Teacake, 11 Amaze, 12 Reside, 14 Played, 18 Maids, 20 Satchel, 22 Lift-off, 23 Tench, 24 Yen, 25 Dalmatian.
**Down:** 1 Lobster, 2 Tiara, 3 Awkward, 4 Golfer, 5 Cobra, 6 Germany, 7 Thyme, 13 Sailfin, 15 Letitia, 16 Dolphin, 17 Useful, 18 MOLLY, 19 Sword, 21 Hindi.

**ID PARADE ANSWER**

Congo tetra (*Phenacogrammus interruptus*)

**SICK LIST ANSWERS**

The missing word is Hexamita, and the one that is incorrectly spelt is Lymphocitis. It should be Lymphocystis.


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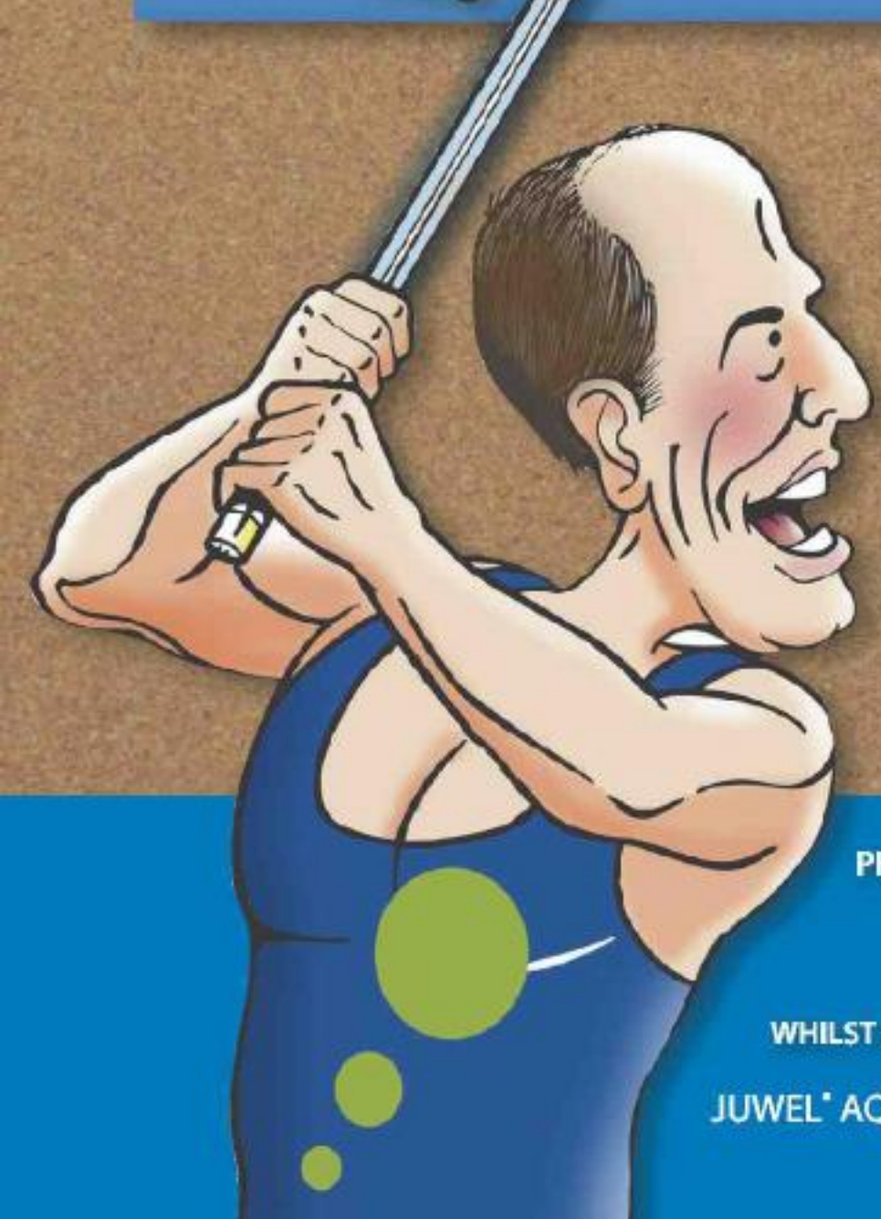


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*All tank photos courtesy of George Farmer*

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