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TRANSLATOR | Stephan M. Tanner, Ph.D.
ART DIRECTOR | Linda Provost
DESIGNER | Anne Linton Elston
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Louise Watson, John Sweeney, Eamonn Sweeney
EDITORIAL & BUSINESS OFFICES |
Reef to Rainforest Media, LLC
140 Webster Road | PO Box 490
Shelburne, VT 05482
Tel: 802.985.9977 | Fax: 802.497.0768
BUSINESS & MARKETING DIRECTOR |
Judith Billard | 802.985.9977 Ext. 3
ADVERTISING SALES |
James Lawrence | 802.985.9977 Ext. 7
james.lawrence@reef2rainforest.com
ACCOUNTS | Linda Bursell
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COVER:
Tylomelania species.
Images by H.-G. Evers.

Dear Reader,

Do we have to deal with slimy creatures, and even confront them on the cover of *AMAZONAS*? In this issue, yes, we do, but fortunately it's all part of broadening our aquatic horizons and bringing seductive new species into our aquariums. In our hobby, snails are no longer just invasive fish food consumers; to many fans, including many newcomers, aquarium snails are attractive and interesting animals.

The diversity of "shell carriers" available from tropical fish livestock sources has exploded in recent years. Someone must be buying these animals—otherwise, why would they be available? Isn't it about time we reported on these mollusks in a little more detail? We thought so, and our snail expert, Maike Wilstermann-Hildebrand, agreed to cover the topic in this issue.

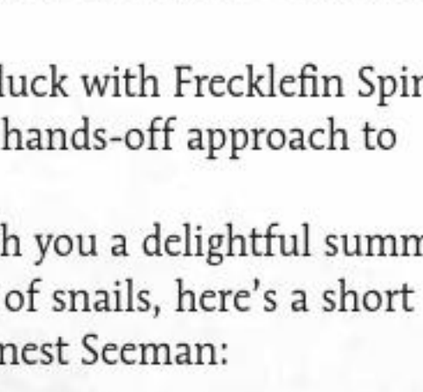
We also have something special for our fish fanatics in this issue. Many of us keep the hillstream loaches of Borneo in our aquariums, and a fair number of aquarists have been struggling to breed these animals—so far unsuccessfully. But Heinrich Gewinner has managed to succeed, and you can read about it here.

Those who like even more unusual fishes might try their luck with Frecklefin Spiny Eels; Jutta Bauer reports here on her success with an entirely hands-off approach to breeding this supposedly "difficult" species.

To our growing worldwide English edition audience, I wish you a delightful summer and a season of joy with our wonderful hobby. And speaking of snails, here's a short poem on the topic by Joachim Ringelnatz, as translated by Ernest Seeman:

The Snail

Blowing softly on a snail
Makes him shrink into his shell.
Dipping him in cognac, mixed with ice,
Soon has him seeing white mice.



"The Snail" is an excerpt from the original poem "Überall" (German for "Everywhere"), 1933. Note: White mice are the German equivalent of pink elephants.

Below: The editor wades into local waters on a collecting trip organized by the All-Aquarium Catfish Convention to the Rivanna River in central Virginia, fall 2012.

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One of two new licorice gouramis: Parosphromenus phoenicurus, male

Three new labyrinth fishes (Anabantoids)

by Stefan van der Voort • In December 2012, three new species of labyrinth fishes (Anabantoids) were described: *Parosphromenus phoenicurus* and *Parosphromenus gunawani* from eastern Sumatra and *Betta siamorientalis* from eastern Thailand. We now recognize 20 *Parosphromenus* and 27 *Betta* species.

Parosphromenus phoenicurus

Horst Linke discovered *Parosphromenus phoenicurus* Schindler & Linke, 2012 in 2008, and introduced it to the aquarium hobby under the name *Parosphromenus* sp. "Langgam." The new species of licorice gourami differs from all other *Parosphromenus* in the rhombic shape of the caudal fin (as opposed to rounded or filamentary extended tail fins in the other species). The scientific name derives from the Greek "phoenix" (dark red) and "urus" (tail).

As far as is known, the species lives only in the drainage of the Sungai Kampar near the village of Langgam, about 25 miles (40 km) southeast of Pekanbaru in the Riau province of central Sumatra, Indonesia. The type locality is a blackwater swamp near Kota Kerincikiri. Linke collected there in January 2008 and found the following water parameters: pH 5.25, 7 µS/cm, 80.2°F (26.8°C).

Like all the *Parosphromenus* species, *P. phoenicurus* does best in a 24-inch (60-cm) single-species aquarium. The water parameters should be as close as possible to those in the natural habitat. The type thrives best at a very low current, which can be easily generated with a sponge filter. The tank should be planted densely in places to offer shelter to the animals.

P. phoenicurus is a bubble nest builder. The male builds a nest under a floating piece of cork bark or a leaf, where he will care for the eggs. After spawning, the female can be removed in

H. LINKE

Parosphromenus gunawani, male, previously known to aquarists as *P.* sp. "Danau Rasau."

order to prevent her from preying on the hatching brood.

Parosphromenus gunawani

As with the above species, *Parosphromenus gunawani* Schindler & Linke, 2012 was also discovered by licorice gourami expert Horst Linke in 2008 and introduced to the hobby under the name *Parosphromenus* sp. "Danau Rasau."

P. gunawani has a rounded tail fin with a shiny blue vertical band. The species lacks a black spot on the dorsal fin, which is a common trait for the genus. Typical is a reddish-brown banding in the dorsal and anal fins. The species was named in honor of Mr. Gunawan "Thomas" Kasim, a well-known aquarium fish exporter, who supported the discoverer on his travels in Sumatra.

Below: *Betta siamorientalis*, displaying males.

Planted Aquarium Set-up
Phase 1: Prepare the water.
Adjust and maintain critical water parameters for general health of the inhabitants. Carbonate and General Hardness, as well as pH, are key.

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The species lives in the northwestern part of the province of Jambi on Sumatra. The type locality is a swamp with a water depth of 1–3 feet (30–100 cm). The surface is partially overgrown with floating plants, and the water is shaded by nearby trees. Linke measured the following water parameters in May 2008: pH 4.1, 30 µS/cm, 84°F (29°C). Due to strong rains, a slight current was observed. The care and breeding of these animals in the aquarium does not differ from that of *P. phoenicurus*.

Betta siamorientalis

Betta siamorientalis Kowasupat, Panijpan, Ruenwongsa, & Sriwattanarothai, 2012 has been known to aquarists for some time under various trade names, such as *Betta* cf. *imbellis* or "Black Imbellis." The Thai locals have considered it a form of *Betta splendens* because of the two red bars on the gill cover; they also call it *Betta* sp. "Kabinburi." The describers assigned *B. siamorientalis* to the *Betta splendens* group, along with *B. splendens*, *B. smaragdina*, *B. imbellis*, *B. stiktos*, and the recently described *B. mahachaiensis*.

B. siamorientalis has a black-brown body color, a black operculum with the aforementioned red twin bars, a red spot pattern on the gill membrane, and a red outlined caudal fin with a thin black margin. The rear half of the anal fin is red and the red-black ventral fins have white tips.

The species name refers to its origin. Siam is the old name for Thailand and the Latin name "orientalis" means "east," a reference to eastern Thailand, the area of origin of the species.

B. siamorientalis inhabits various habitats in Thailand, such as flooded savanna planes, rice fields, the densely planted edges of ponds, lagoons, canals, and similar habitats. The species prefers dense vegetation in order to be protected from predators and to build a foam nest. They share their habitat with many other fish species: *Trichopsis vittata*, *T. schalleri*, *T. pumila*, *Trichopodus trichopterus*, *Anabas testudineus*, *Lepidocephalichthys hasselti*, *Pangio anguillaris*, *Macrognathus siamensis*, and *Monopterus albus*.

Betta species are actually not suitable for community aquariums. *B. siamorientalis* is no exception, and is best maintained in a densely planted species aquarium. A 24-inch (60-cm) tank is completely sufficient. Slight water movement from the filtration, slightly acidic and soft water, and an average water temperature of 77–81°F (25–27°C) fully satisfy the requirements. Live and frozen foods of all kinds are accepted, but fatty foods such as *Tubifex* should be fed sparingly.

Floating plants facilitate the building of a foam nest. Usually, keeping several males together in an aquarium does not work out. The species is quite aggressive and a dominant male will vigorously fight with all competitors. On the other hand, several females can be kept together. After spawning, I remove the female so as not to jeopardize the hatching fry later.

I thank Horst Linke for the pictures and Matt Ford of Seriously Fish (www.seriouslyfish.com) for the information on *Betta* sp. "Kabinburi."

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How old do aquarium fishes get?

by Wolfgang Seifert • I am not aware of very much truly reliable information about the life spans of various fishes in aquariums. Much of the reported "data" is anecdotal and far from scientific. That fishes get older in the aquarium, where there are no predators, than in nature is undisputed—but diseases and mistakes made during care may shorten their lives. Information about age can therefore only be a point of reference. Among catfishes, a life expectancy of 7–12 years for Corys is normal, but for bigger catfishes 10–15 years or more is not unusual.

To research the maximum possible age for a Bristlenose Catfish was certainly not the reason I set up a small 10-gallon (40-L) aquarium for my two children in the fall of 1984. We did not have much space, but the motivation was clear: nature was important for the kids. A few Guppies and two young Bristlenose Catfish (*Ancistrus* sp.) were added. They had hatched in the spring of 1984, and came via my brother-in-law from a colleague at work. Actually, we were very lucky because they became a pair; however, for many years they mostly avoided

Our *Ancistrus* male at the age of around 27 years.

each other. This small aquarium remained their home until the turn of the millennium. The tank was furnished with a glass tube from an old filter, a small root for grazing, a few rocks, *Cryptocoryne*, small *Sagittaria*, and dwarf sword plants. The male set up his territory around the glass tube and the female dug a shelter under the root. There were even two feeding areas.

I cannot be 100 percent certain, but I don't think they have ever spawned during this time. Perhaps the small aquarium did not meet their size requirements, or maybe the care conditions were not optimal (I only took the time to become a full-blooded aquarist in later years).

Anyway, all that changed in 2001 when the two catfishes were moved into a new 20-gallon (80-L) tank with more space, more hiding places, perhaps more complete nutrition, and regular partial water changes of about 3–4 gallons (10–15 L) per week. Since then, they (or, more specifically, the male) have raised one brood after another, and in 2006 both catfish still looked good. It really seemed as if they had been saving their life energy for their golden years.

Then, in the fall of 2007, I found the female dead in the tank one morning. She was more than 23 years old. After some discussion, we decided to get a young female for the lonely male. Apparently this mobilized the male again, and a few months later he was back in his cave, fanning the next brood.

Until this year, I could not complain of a lack of *Ancistrus* fry—in fact, at times I found it tough to accommodate all the young catfish. But in early November 2012, the old male's health went rapidly downhill, and his life ended—after 27.5 years!

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Best in Show:
Amphilophus hogaboomorum

OCA Extravaganza

by Anja Rößler • Every year, a week before Thanksgiving, the cichlid and catfish convention known as OCA Extravaganza takes place in Strongsville, Ohio. In 2012, from November 16 to 18, many enthusiastic aquarists gathered at one of the largest conventions of its kind in the United States. It is organized by the Ohio Cichlid Association (OCA), also based in Strongsville. More than 500 visitors attended from neighboring states and came from as far away as Texas and Minnesota. Even other countries, including Canada, England, and Australia, were represented last year.

The meeting was held in two large rooms at the Holiday Inn in Strongsville, where business owners and manufacturers were selling products, such as ceramic breeding caves, specialty aquascaping wood, foods, and books. On two of the hotel's floors, the attendees had transformed the hotel rooms into mini pet stores. Everywhere you looked, people wore colorful T-shirts printed with fishes and the logos of aquarium clubs.

In the show room, the fishes for the show competition were housed in some 180 tanks. On Saturday, the main convention day, cichlids and catfishes in various categories were rated by a jury based on different criteria such as rarity, size, color, finnage, and condition. A very large, beautiful cichlid from Central America, *Amphilophus hogaboomorum*, became "Best in Show," but the other winners did not need to hide either.

Inspired by the motto "Decorate your very own aquarium," the youngest visitors, with the help of club members, set up and aquascaped some 20 aquariums donated by a sponsoring manufacturer.

At a Saturday afternoon swap meet, hundreds of customers crowd to the sellers' booths.

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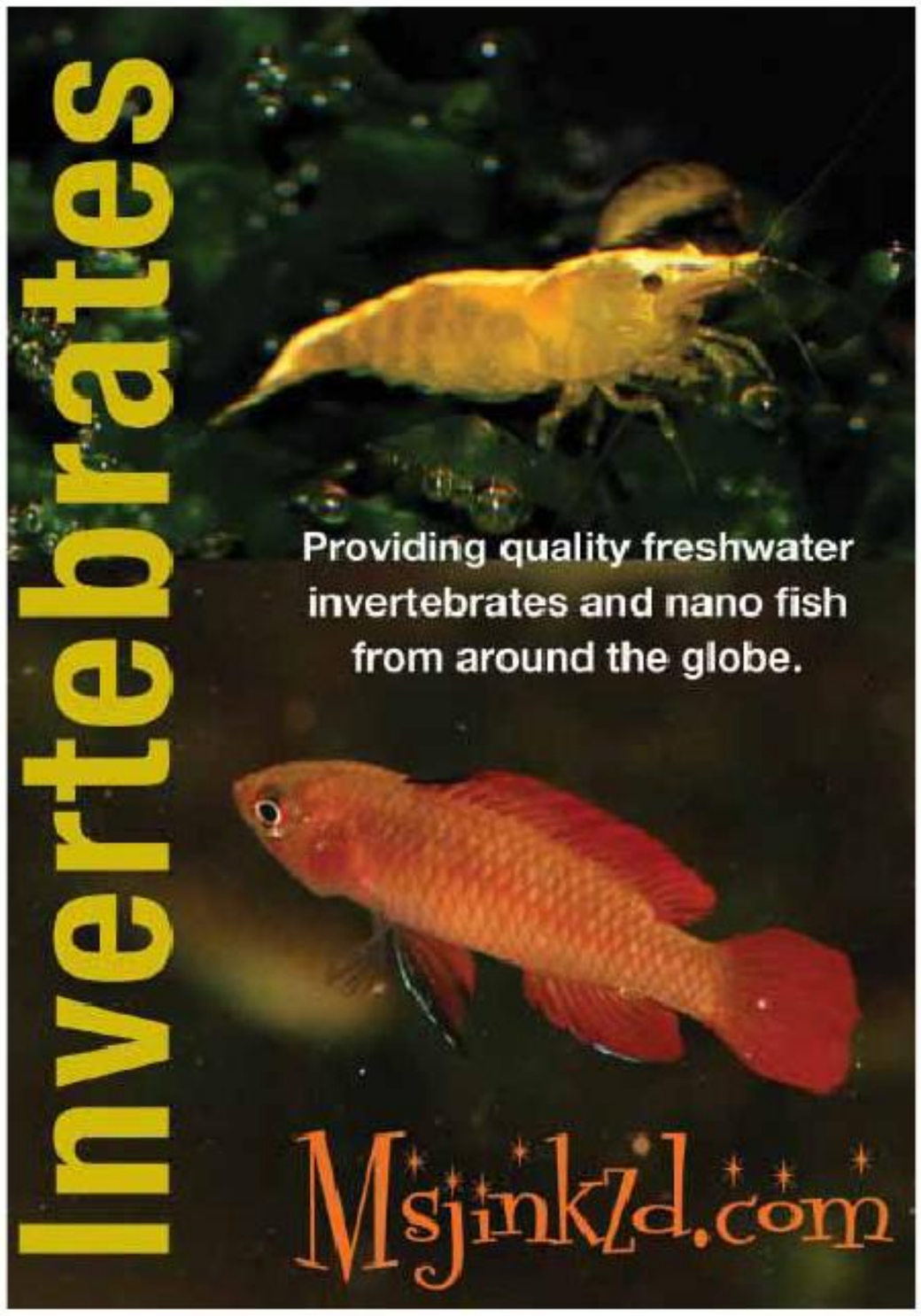
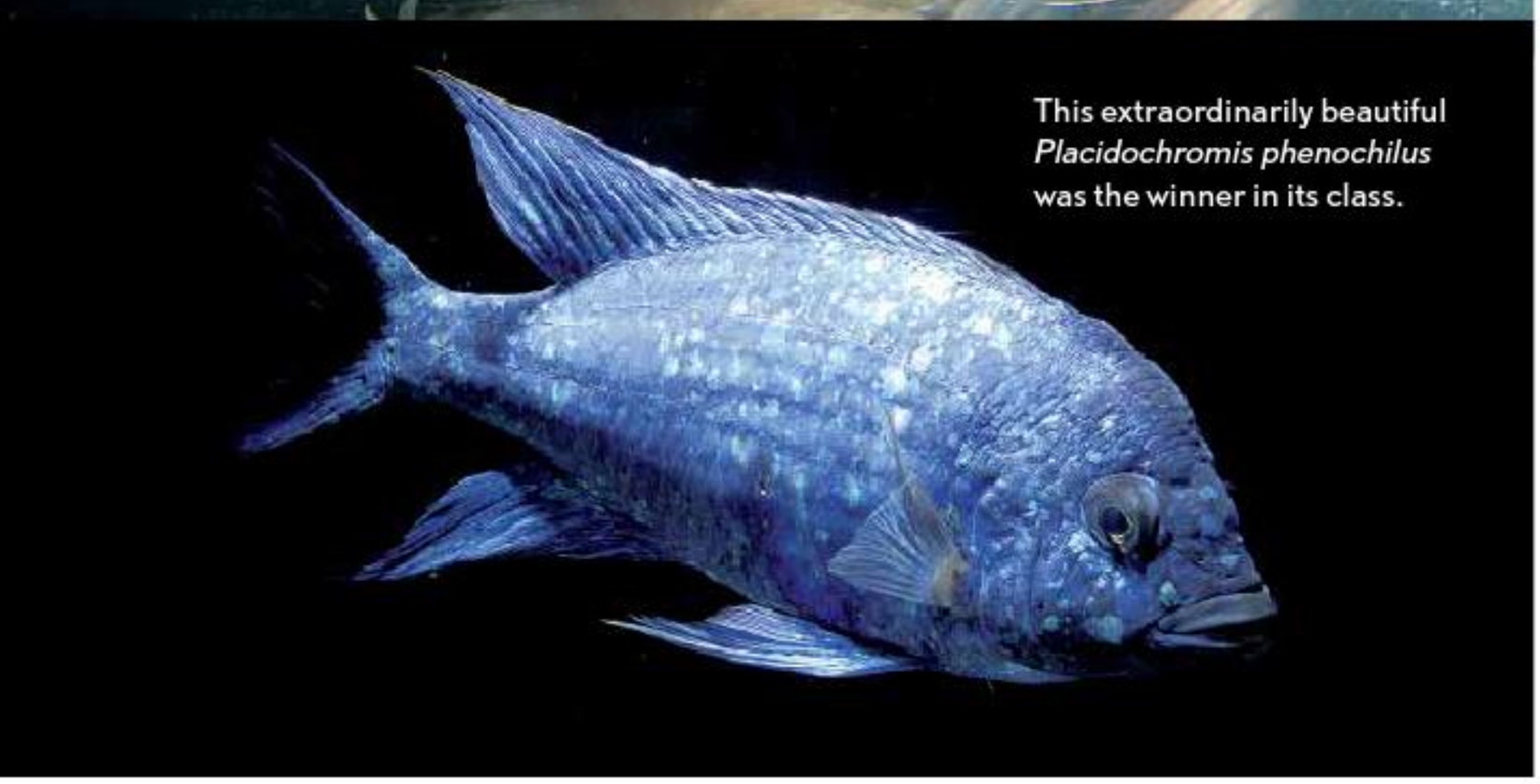


J. KUHNE

Overall winner in the catfish category: a magnificent male *Corydoras concolor*.



This extraordinarily beautiful *Placidochromis phenochilus* was the winner in its class.

The expert lectures were not to be missed. Topics ranging from habitats to the latest taxonomic changes were presented by African-cichlid expert Ad Konings, *AMAZONAS* editor Hans-Georg Evers, and ichthyologists Jay Stauffer and Michael Tobler. These lectures were well attended—more than 100 people crowded into the lecture hall to hear some of them. Additionally, a "meet and greet" with the speakers was held on Saturday afternoon.

A special feature of such events is the opportunity for attendees to sell their tank-raised fishes out of their hotel rooms. Racks and aquariums were dragged in and set up the day before. During the following nights, with all the room doors open, the strolling hobbyists were invited to gather and discuss fishes over beer and snacks. Quite a few aquarists from around the area took the opportunity to stock up on fishes.

Sunday is traditionally the day of the big fish auction. Thousands of bags of cichlids, catfishes, and accessories are made available to interested parties to bid on. The auctioneer rattles off numbers at lightning speed into the microphone, buyers raise their hands, and it is not unusual to observe interesting "duels" between competing buyers, after which some fishes change hands at surprisingly high prices.

The jury at work. Evaluating the fishes took hours.

TOP: H.-G. EVERS; BOTTOM: C. TROSSLER

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article and images by Ronny Lundkvist • translation by H.-G. Evers

Do mollies need salt?

The regularly asked question of whether mollies require salt can be answered both *yes* and *no*, specifically because it depends entirely on the habitat the fishes come from. There are species that live in completely fresh water and others that are found in brackish or even sea water. Mollies are very salt tolerant, so individuals of the same species can inhabit totally different types of water.

If you plan to keep mollies, it is in fact always a good idea to add salt, by which I mean not standard cooking salt from the supermarket, but the sea salt used in the marine aquarium hobby. As a rule, 1 heaping teaspoon per 2½ gallons (10 L) of fresh water will provide the fishes with adequate minerals. In areas with very soft tap water, somewhat more may well be required.

Male *Poecilia latipinna* from completely fresh water, Sweet Bay Pond, Everglades National Park, Florida.

In recent years I have visited a number of molly habitats in Central America and the Caribbean and measured the parameters of the water, which is generally very hard.

Water analysis method 2003 and 2004: ICP-OES (Inductively Coupled Plasma—Optical Emission Spectrometer):

Lago de Atitlán, Guatemala

Habitat of one of the short-finned mollies of the *Poecilia sphenops* species complex

Mineral content in November 2003:

Sodium (Na^+)	47 mg/l
Calcium (Ca^{2+})	24 mg/l
Magnesium (Mg^{2+})	21 mg/l
Total hardness	**8.2°dGH**

Rio Dulce, eastern Guatemala

Habitat of *Poecilia mexicana*

Mineral content in November 2003:

Sodium (Na^+)	6.4 mg/l
Calcium (Ca^{2+})	21 mg/l
Magnesium (Mg^{2+})	7.5 mg/l
Total hardness	**4.7°dGH**

Lago de Petén near Flores, Guatemala

Habitat of *Poecilia petenensis* (formerly *P. gracilis*), *Poecilia kykesis* (formerly *P. petenensis*), and *Poecilia mexicana*

Mineral content in November 2003:

Sodium (Na^+)	12 mg/l
Calcium (Ca^{2+})	21 mg/l
Magnesium (Mg^{2+})	21 mg/l
Total hardness	**7.8°dGH**

Cenote Paraíso, Xel-Ha, Riviera Maya, Mexico

Habitat of *Poecilia orri*, Mangrove Molly

Mineral content in April 2004:

Sodium (Na^+)	3200 mg/l
Calcium (Ca^{2}+)	200 mg/l
Magnesium (Mg^{2+})	400 mg/l
Total hardness	**120°dGH**

Cenote Xtabay, south of Puerto Aventuras, Riviera Maya, Mexico

Habitat of *Poecilia orri*, Mangrove Molly

Mineral content in April 2004:

Sodium (Na^+)	680 mg/l
Calcium (Ca^{2+})	130 mg/l
Magnesium (Mg^{2+})	99 mg/l
Total hardness	**41°dGH**

Tres Rios, estuary, Riviera Maya, Mexico

Habitat of *Poecilia velifera*, Yucatán Sailfin Molly

Mineral content in December 2003:

Sodium (Na^+)	3000 mg/l
Calcium (Ca^{2+})	150 mg/l
Magnesium (Mg^{2+})	360 mg/l
Total hardness	**100 °dGH**

Tres Rios, Cenote Aguila, Riviera Maya, Mexico

Habitat of *Poecilia velifera*, Yucatán Sailfin Molly

Mineral content in April 2004:

Sodium (Na^+)	1200 mg/l
Calcium (Ca^{2+})	150 mg/l
Magnesium (Mg^{2+})	160 mg/l
Total hardness	**8°dGH**

Wetlands in the northwest of Aruba

Habitat of *Poecilia vandepolli*

Mineral content in December 2004:

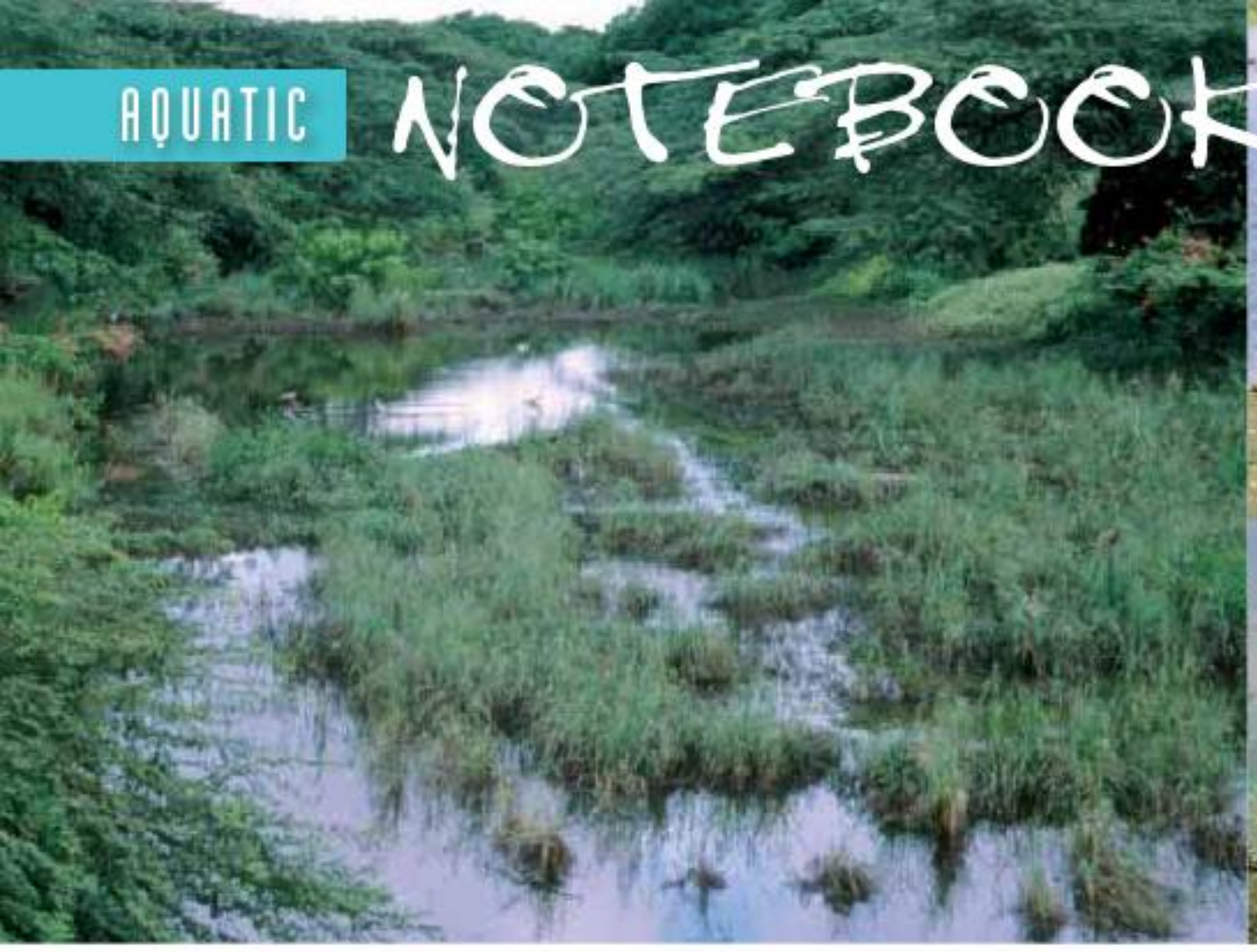
Sodium (Na^+)	3300 mg/l
Calcium (Ca^{2+})	130 mg/l
Magnesium (Mg^{2+})	260 mg/l
Total hardness	**78°dGH**

Seasonal stream near Willemstad, Curaçao

Habitat of *Poecilia vandepolli*

Mineral content in December 2004:

Sodium (Na^+)	94 mg/l
Calcium (Ca^{2+})	37 mg/l
Magnesium (Mg^{2+})	18 mg/l
Total hardness	**9.3°dGH**



Seasonal stream near Willemstad on Curaçao.

Wetland in the northwest of Aruba.

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Calcium and magnesium are especially significant components.

Even though the black mollies so popular in the aquarium hobby, tank-bred for decades, are quite happy in completely fresh water, this doesn't mean that the wild forms of *Poecilia latipinna* and *P. sphenops* can get by without a high mineral content. The sailfin mollies, such as *P. latipinna* and *P. velifera*, do much better if marine salt is added to the aquarium water. They are less susceptible to bacterial infections, grow more vigorously, and appear generally healthier overall. But make sure that the aquarium contains only other salt-tolerant fish species as tankmates, and remember that there will be fewer aquarium plants to choose from.

This male *Poecilia latipinna* was caught in pure sea water at Key Largo, Florida.

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Crayfishes compete for optimal water temperatures

Above: The Louisiana Crayfish is a popular aquarium species.

Below: Portrait of *Procambarus clarkii*

by Ralf Theuer • The survival of many animals depends on their ability to compete for resources—food, water, shelter, or territory. But could optimal temperatures be an equally valuable resource for cold-blooded species—and a reason for territorial disputes? Canadian scientists led by Glenn J. Tattersall have observed this type of competition in the Louisiana Crayfish, *Procambarus clarkii*. When it comes to securing a territory with the right temperature, this crayfish shows behaviors similar to those seen in traditional intraspecific rivalries.

The behavior of the Louisiana Crayfish was recorded with video cameras and analyzed later. The experimental containers (so-called shuttle boxes) were divided in two. Using two computer-controlled coffee makers, each half was set to and maintained at a different temperature. First, the scientists identified the temperature at which the animals felt particularly comfortable and did not migrate into the other half of the box. The preferred temperature was 75°F (23.9°C).

In the next experiment, two specimens of the crayfish were placed in the test tank at the same time. One half was at the preferred water temperature, while the other side was either colder (71.2°F/21.8°C) or warmer (78.6°F/25.9°C). If the animals were familiar with each other and had already established a hierarchy, there was very little aggressive behavior. The dominant crayfish then occupied the part of the tank with the optimal temperature, while the weaker individual retreated to the other half. Occasionally, both crayfishes shared the preferred chamber.

However, if the two animals were unfamiliar with each other, they competed for the side with the preferred temperature. A hierarchy was usually established after half an hour, but the lower-ranking animal tried again and again to take over the side with the optimal water temperature.

The higher temperature of 78.6°F/25.9°C appears to stimulate those territorial disputes more than the cooler temperature (71.2°F/21.8°C). The biologists believe it is possible that environmental factors, such as the flow rate or the oxygen content of the water, could be the underlying resources the crayfish competed for.

REFERENCES

Tattersall, G.J., et al. 2012. Thermal games in crayfish depend on establishment of social hierarchies. *J Exp Biol* 215: 1892–1904.

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A Gallery of GREAT AQUARIUM SNAILS!

by Maike Wilstermann-Hildebrand • Aquatic snails may be the least appreciated animals available to tropical fish enthusiasts, and many people simply classify most snails as scavengers—or just pests. In fact, there are many highly desirable snails out there, some quite beautiful and fascinating to watch, and new species are regularly imported. This guide is meant to help distinguish the snails you may want from those that are best avoided.

Ampullariidae—Apple Snails

The apple snail is a successful model of nature: it has existed in its present form for more than 150 million years. Apple snails have been around since the days of the dinosaurs and have been kept by generations of aquarium keepers. They are undemanding and relatively resilient.

Ideal for aquariums is the **SPIKE-TOPPED APPLE SNAIL**, *Pomacea diffusa*. They eat no living plants, but consume food leftovers and other organic material, and thus make a major contribution to the cleanliness of the aquarium. The variety of available color morphs contributes to their popularity. A white to

H.-G. EVERS

Left: Portrait of a Blue Apple Snail.

Right: The Spike-Topped Apple Snail, *Pomacea diffusa*, stands out because of its many colorful morphs.

off-white or blue-black body color can be combined with yellow, brown, purple, pink, or white shells. The shells of these animals average 1.6–1.8 inches (40–45 mm) in size. They lay their eggs outside the water in calcareous cocoons that contain 100–250 eggs and, with a size of 1–2 inches (2.5–5 cm), are easy to find. They can be removed easily when no offspring are desired.

The **ZEBRA APPLE SNAIL**, *Asolene spixi*, has a white to gray, brown-speckled body and a yellow shell with brown or black lines. They feed mainly on uneaten food. They may partially eat the shoots and leaves of soft plants, but in a densely planted aquarium this is barely noticeable. They lay gelatinous egg casings containing 10 to 30 eggs underwater on plants or decorations. After about 14

The Zebra Apple Snail, *Asolene spixi*, causes little visible damage to plants if the population is not too large.

TOP: M. HAKANSON; BOTTOM: M. WILSTERMANN-HILDEBRAND

days the eggs hatch. As long as the population is not too large, these snails do not cause significant damage.

Other apple snails, such the Channeled or Golden Apple Snail, *Pomacea canaliculata*, the Apple Snail, *P. glauca*, and *Marisa cornuarietis*, all eat plants, including *Anubias*, Java Fern, and *Cryptocoryne*, so they are not suitable for planted aquariums. However, the animals are easy to maintain and are kept by many snail fans. Apple snails live to be about two years old.

Thiaridae—Thiarids

Snails of the family Thiaridae are, in principle, all suitable for the aquarium. *Melanoides tuberculata*, the **MALAYSIAN (OR MALAYAN) TRUMPET SNAIL** (often abbreviated to MTS, aka the Malayan livebearing snail), is considered the "earthworm of the aquarium." These animals are all female and reproduce via unfertilized eggs, which they keep in a brood pouch behind their heads until the young hatch and are released into the water. The proliferation rate is very high and with a good supply of food, the animals multiply *en masse*. In the aquarium, the shells rarely get longer than 0.4–0.6 inch (1–1.5 cm). In nature, these animals reach a shell length of 2.4 inches (6 cm) or more.

The **PAGODA TIARA**, *Thiara scabra*, has a 0.6 inch (1.5 cm) shell with bulbous turns and nodes and thorns on the ridges. These animals also reproduce by parthenogenesis and bear live young. But they proliferate more slowly than *Melanoides tuberculata* and cannot compete with them. Therefore, you should not mix these species.

Typical for the large **HAIRY TRUMPET SNAIL**, *Thiara cancellata* (up to 1.2 inches/3 cm), are the stiff, rear-facing bristles. The animals look interesting and are long-lived in aquariums. They produce free-floating larvae, which, unfortunately, have not yet been successfully reared in the aquarium.

The nests of bladder snails are found throughout the tank on plants and equipment if the animals are satisfied with the conditions. Very few snail species can reproduce so fast in the aquarium.

Feeding tracks of the Turreted Nerite, *Neritina turrita*. It is one of the most popular aquarium snails because it completely eliminates algae.

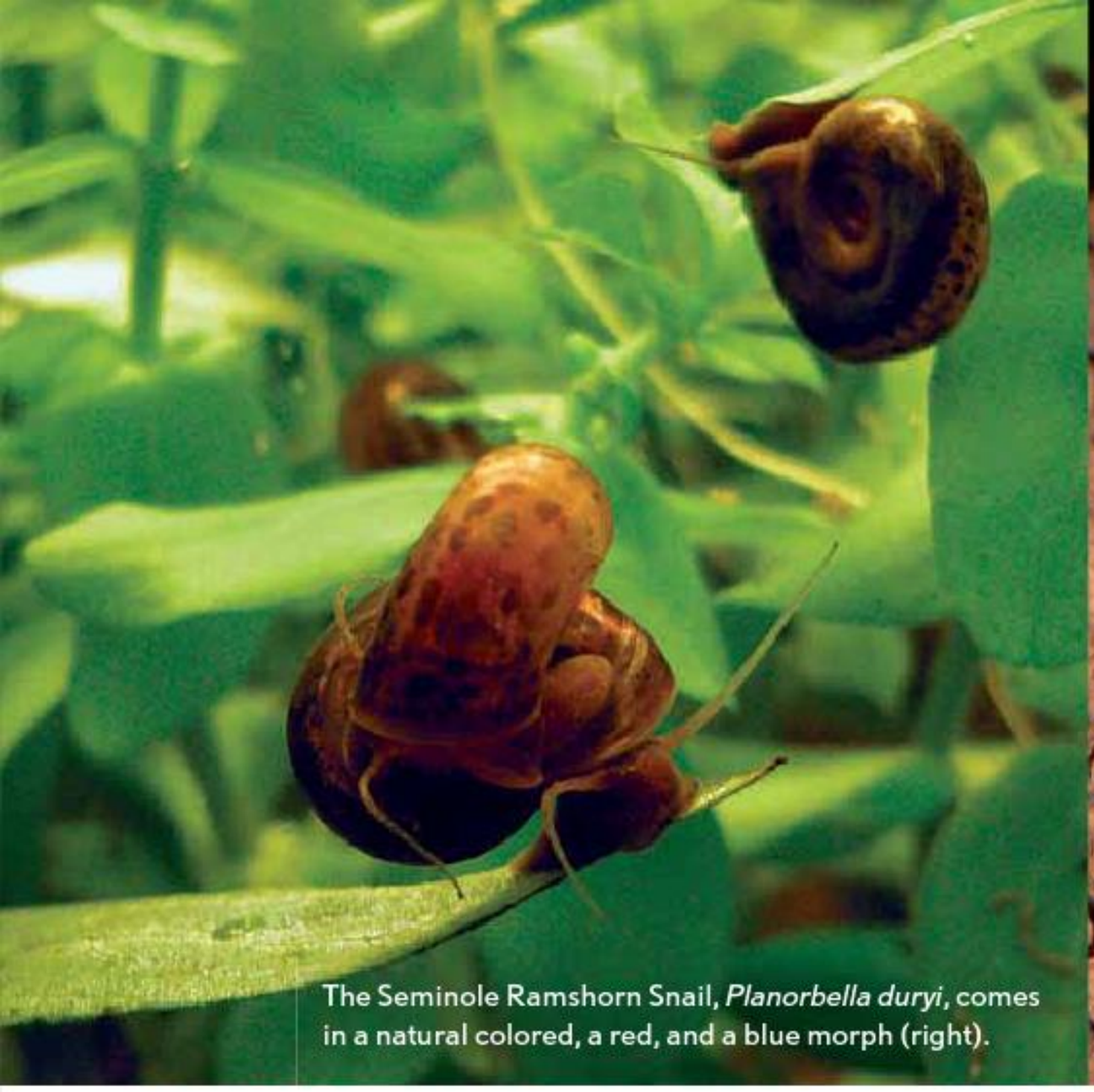
Pachychilidae—Pachychilids

We maintain the genera *Tylomelania*, *Brotia*, and *Faunus* from the family Pachychilidae in our aquariums. With *Brotia* and *Tylomelania* the mortality of newly acquired animals is very high. Their chances of survival seem to depend on how different the water parameters are during transport, holding, and in the aquarium compared to those in their original locality. Captive breeding successes are still very infrequent with these species. Although these viviparous snails often release babies shortly after their arrival, the young rarely survive. Apparently, sexual maturity doesn't begin until the age of one to one and a half years, or even later—and both males and females are needed for breeding.

So far, I have only been able to maintain some **GOLDEN SPOTTED RABBIT SNAILS**, *Tylomelania towutensis*, and one **GIANT TOWER CAP SNAIL**, *Brotia herculea*, over a longer period of time. However, there were no *Tylomelania* babies for over three years. All other *Brotia* and *Tylomelania* species died within three weeks of purchase. They are not very suitable for a community aquarium; they do not like disturbances or competition from other snails or fishes. A species tank is the best way to keep these animals.

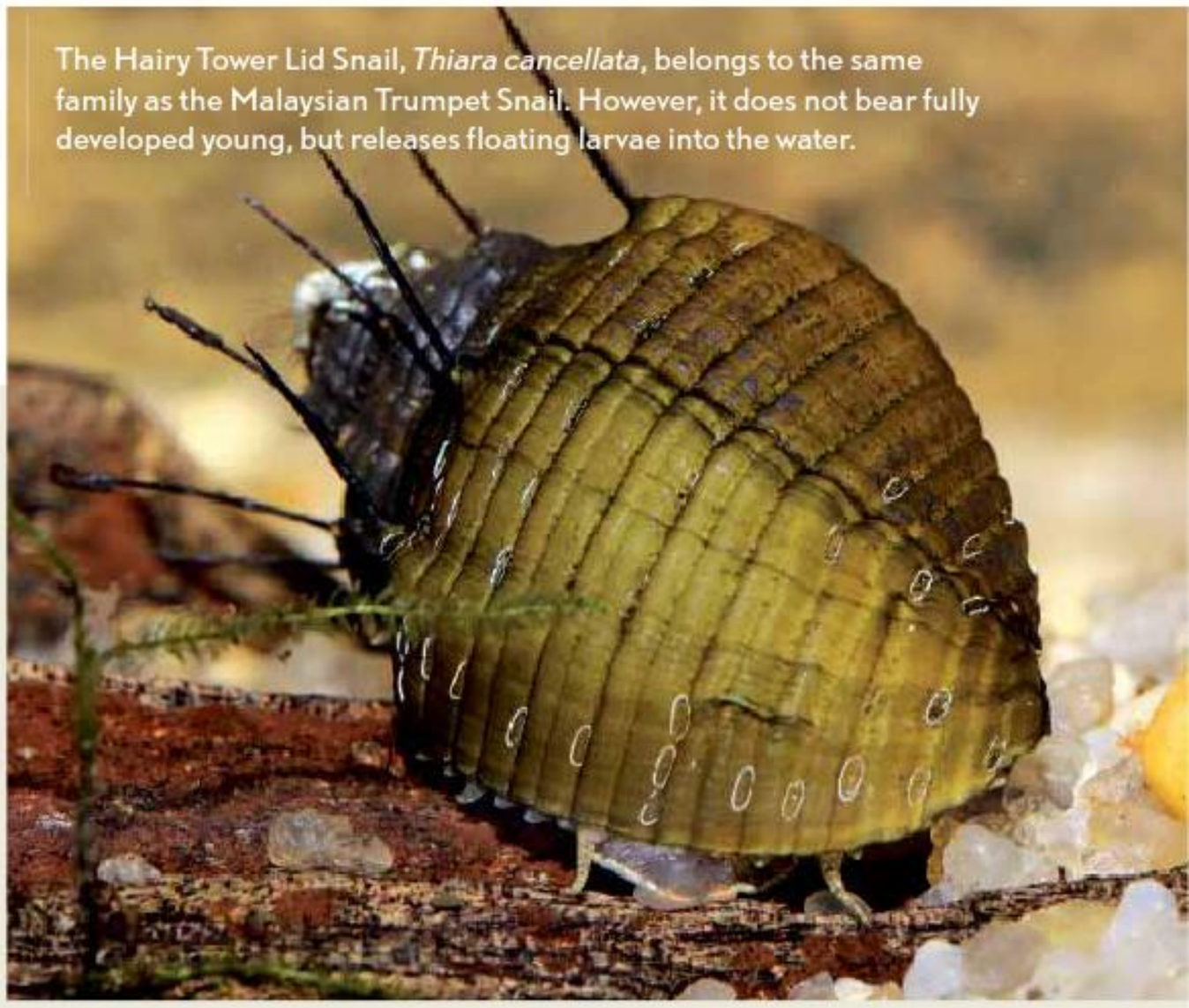
The Spiky or Bumblebee Nerite, *Clithon diadema*, keeps well in the aquarium, but does not reproduce in captivity.

TOP: M. WILSTERMANN-HILDEBRAND; BOTTOM: H.-G. EVERS



The Seminole Ramshorn Snail, *Planorbella duryi*, comes in a natural colored, a red, and a blue morph (right).

Aquarists using special salts with *Tylomelania*, such as those sold for Sulawesi shrimp, report varying results. Some specimens that had been doing well in regular tap water died after the addition of these salts. Other animals did well in the treated water, together with shrimps from the region. The



The Hairy Tower Lid Snail, *Thiara cancellata*, belongs to the same family as the Malaysian Trumpet Snail. However, it does not bear fully developed young, but releases floating larvae into the water.

WHEN SNAILS BECOME A PLAGUE

RAMSHORN, **BLADDER**, and **MALAYSIAN TRUMPET SNAILS** have very high reproductive rates and can proliferate into nuisance-level populations. If plenty of food is available, they multiply to such an extent that they soon cover the entire tank. Getting rid of them or reducing their populations can be a challenge.

First, you should reduce the amount of food offered or add it in several feedings so that everything will be completely consumed by the fishes. This method will not reduce the number of snails, but without an overabundance of food, at least they will not lay new eggs every three to four days. To get rid of the existing snails, you have to collect them by hand or add animals that feed on snails. However, snail eaters need to fit socially into the aquarium and might need replacement food after the snails are gone.

Freshwater shrimps such as *Macrobrachium* spp. are suitable as snail eaters. With their claws they pull smaller snails from their shells, but can also capture small fishes if they are sleeping or resting on the bottom or between plants. For example, male Guppies can easily become victims.

The predatory **ASSASSIN SNAIL** (*Clea helena*) hunts snails and worms. It reproduces quite well and can completely wipe out other snails.

The Dwarf or Pea Puffer (*Carinotetraodon travancoricus*) is very effective against snails. These little fellows meticulously track down small snails and eat them, shell and all. However, after the snails are gone, puffer fish must be weaned onto a replacement diet. In my experience, the puffers consume live and frozen bloodworms, but do not readily accept dry foods. Assassin Snails and the *Macrobrachium* shrimps eat any food, and in this respect are easy to care for. But none of these predators distinguish between desirable and undesirable snail species.

TOP LEFT: M. WILSTERMANN-HILDEBRAND; TOP RIGHT: H.-G. EVERS; BOTTOM: M. HAKÁNSON

The hermaphroditic Egg-Shaped Pond Snail or Wandering Snail, *Radix balthica*, sometimes forms copulating chains in which each snail mates with the one in front of it.

Red Ramshorn Snails, *Planorbis corneus* "Rubrum," are attractive animals and voracious algae grazers. To preserve the red strain, do not mix with Brown Ramshorns.

Blue Apple Snails, *Pomacea diffusa*, hatching from a cocoon. From the opened sac, the babies drop right into the water. These egg cases are easy to spot and remove if population control is needed.

main factor with so-called Sulawesi snails seems to be whether the snails were collected in lakes or in the Indonesian river tributaries. Unfortunately, information on their original habitat is hard to come by when purchasing these snails.

Less demanding is the **BLACK FAUNUS**, *Faunus ater*. This snail is very long-lasting and robust. The smooth, dark brown to black shell can be over 3 inches (8 cm) long. Since these snails release free-floating larvae, they do not multiply in the aquarium.

Because *Neritina pulligera* never leaves the water, the aquarium does not need to be completely sealed.

Neritidae—Nerites & Fruit Snails

Nerites and "Fruit Snails" belong to the family Neritidae. They eat stubborn green algae and diatoms by cracking the sometimes very hard algal cells growing on the substrate and digesting their contents. The **TURRETED NERITE**, *Neritina turrita*, the **BASEBALL HELMET NERITE**, *N. pulligera*, and the **HORNED NERITE**, *Clithon diadema*, are very durable aquarium snails. They effectively consume algae but also take uneaten food. Unfortunately, they cannot reproduce in the aquarium because the tiny planktonic larvae that hatch from their showy white egg cocoons require salt water to mature.

The aquarium should be well covered, because most of these animals leave the water from time to time and are liable to fall off the edge of the aquarium. Although they can survive for some time out of the water, they should not be on dry land for too long. The life expectancy for nerites is 10–15 years.

Septaria and some *Clithon* species have a very high mortality rate. They come in part from brackish water, or refuse substitute food and starve in the aquarium. Therefore, they are not recommended for the hobby.

Viviparidae—River Snails

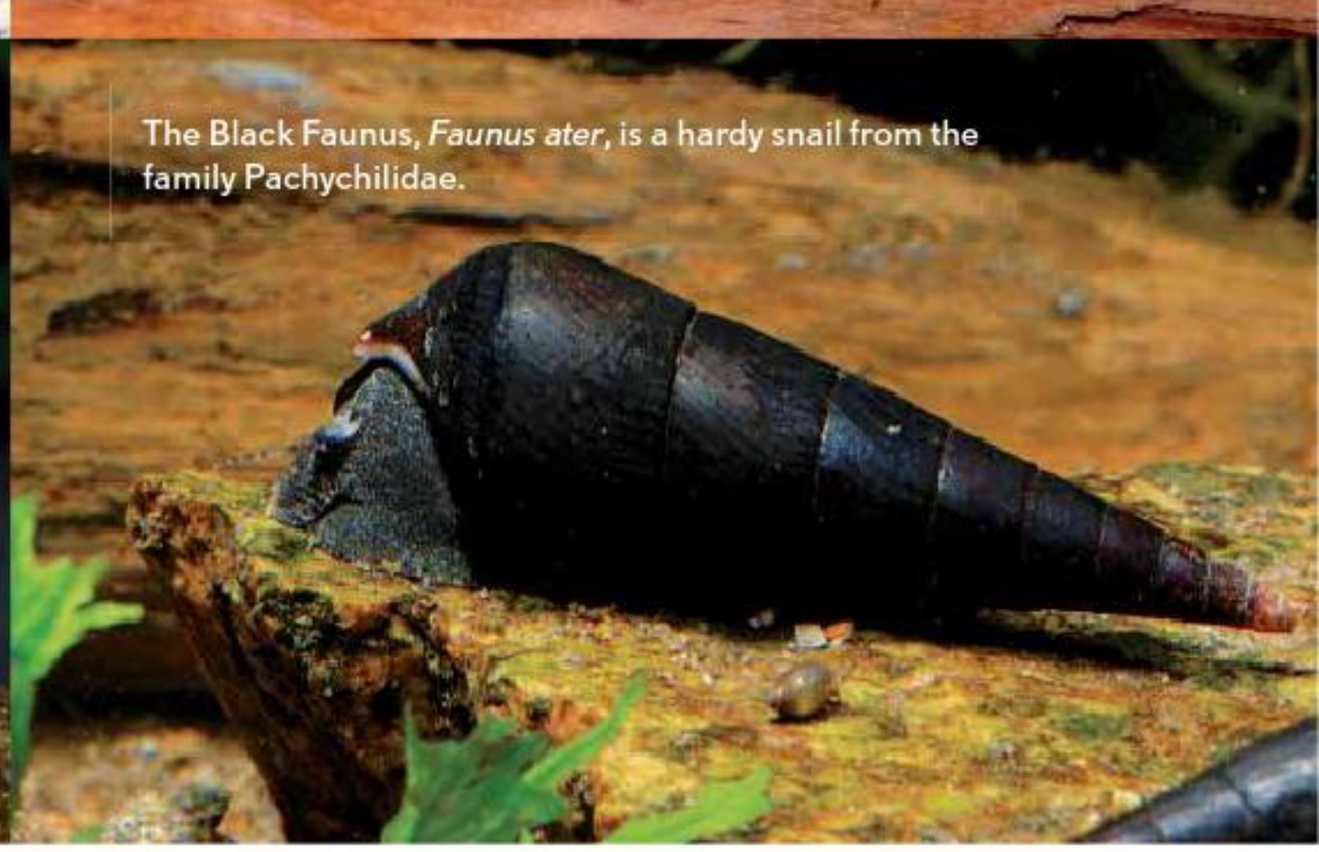
New species from the family Viviparidae are introduced into the aquarium trade regularly, but most do not last long. However, a very good aquarium snail is the **NUBBY PIANO SNAIL**, *Taia naticoides*. Sexually mature specimens have a light brown to dark brown striped housing with fine nodules. The shells of young snails are smooth.

M. WILSTERMANN-HILDEBRAND

Red Spot Nerite, *Neritina semicona*. *Neritina* species accept dry fish food and are easy to maintain.

Malaysian Trumpet Snails, *Melanoides tuberculata*, can reproduce *en masse*.

The Assassin Snail, *Clea* (*Anentome*) *helena*, helps curb snail populations.



The Black Faunus, *Faunus ater*, is a hardy snail from the family Pachychilidae.

The Nubby Piano Snail, *Taia naticoides*, is so far the only species of the family Viviparidae that seems suitable for the aquarium.

The animals reproduce quite well in the aquarium and can handle competition from other snails.

The **THAI TIGER SNAIL**, *Filopaludina sumatrensis,* has not been kept in captivity with lasting success. Although the adult snails release juveniles, they usually die within a few days, and even the adult animals rarely survive longer than four weeks in the aquarium.

Completely unsuitable for the aquarium is the **BLUE TURBO SNAIL**, *Celetaia persculpta*, from Lake Poso, Sulawesi. The animals do not adjust to normal freshwater aquariums—even in tanks in which the conditions of the natural habitat were replicated, these animals lasted a few weeks at most.

"Pulmonata"—Pulmonates

POND, **RAMSHORN**, and **BLADDER SNAILS** are often perceived as pests or threats to plants. In fact, they are ideal aquarium animals. With the exception of pond snails (Lymnaeidae) with shells larger than 0.4 inch (1 cm), they do not harm plants, but eat only dead and diseased plant tissue, algae, uneaten food, and dead animals. Dot-shaped holes in the plant leaves are caused when the snails feed on the dead tissue caused by potassium deficiency. Only very large pond snails eat living plant tissue.

These snails become sexually mature within a few weeks. They are hermaphroditic and lay many eggs in a short time, breathe atmospheric oxygen, and cope well with polluted water. Their numbers depend on how much excess feed gets into the aquarium. If you don't want to reduce the amount of food because some fishes might not get enough, you can dispense the food over several feedings so they can consume everything quickly. Snails only eat what is left over. As a result, they keep the tank clean, reduce the risk of microbial blooms, and combat the proliferation of blue-green algae. In a snail tank, there are usually no algae problems.

TOP LEFT AND BOTTOM: M. WILSTERMANN-HILDEBRAND; THE REST: H.-G. EVERS

Snails with charm:

Tylomelania

Above: The very popular and fantastically colored *Tylomelania* sp. "Orange" is collected in Lake Poso and requires higher temperatures. We also collected very similar animals in the cooler tributaries. This is where the temperature test described in the text becomes helpful.

article and images by Hans-Georg Evers • When discussing the large snails of the genus *Tylomelania*, many people say they are "charming." Probably no other species of mollusks have become so popular in the aquarium hobby in such a short time as these gentle giants from Sulawesi. And the more attention they get from aquarists, the louder the requests for valid information on the habitat and biology of this genus have become. It is time to correct many false assumptions and half-truths about these snails.

On my trips to my dream island of Sulawesi, Indonesia, in addition to many fish and shrimp species I have found the snails of the genus *Tylomelania* and observed them in their natural habitat. When studying the limited scientific literature, I have noticed that the genus has hardly been studied at all. That certainly opens up a huge field for malacologists (scientists who study mollusks). Aquarists have known about these snails only since the Sulawesi shrimp boom began in 2007/2008. In addition to the many fantastically colored *Caridina* shrimp species, various *Tylome-*

lania, with their beautifully shaped shells and attractive colored soft parts, have made dramatic entrances into our tanks.

After a slow but steady spread of the information that these shrimps require high temperatures and slightly alkaline pH values with moderately hard water, it was automatically assumed that the snails from the great lakes of Central Sulawesi also needed to be kept very warm. However, as we know today, this is only partly true. The snails of the genus *Tylomelania* are spread over large parts of Sulawesi. They live in lakes and rivers at higher elevations but also in the large rivers of the low-lying valleys and in the lowlands. So it is fundamentally wrong to treat them all the same.

Unfortunately, the different ecotypes are externally indistinguishable to the layman. So here is my problem: how can I introduce these snails so that after reading the article you will be able to decide which animals to get and how to accommodate them? I will first explain the biology of these fascinating animals and their basic care in captivity, and then cover the various biotopes.

Livebearing snails

The genus *Tylomelania* belongs to the family Pachychilidae, a family whose members

Above, top: Overlooking Lake Poso in the heart of Sulawesi, a diversity hotspot for the genus *Tylomelania*.

Bottom: The Saluopa Falls northwest of Lake Poso is a cooler habitat where we found at least three *Tylomelania* species.

Below: This *Tylomelania* sp. is imported regularly. We recorded this species in cool tributaries (70–73.4°F/21–23°C) of Lake Poso.

A pebble beach on the western shore of Lake Matano. *Tylomelania* can be seen everywhere.

Left: *Tylomelania* sp. on rocks in Lake Poso. A closer look reveals a few baby snails.

Below: *Tylomelania* cf. *centaurus*, with its striking shell, is often found on dead wood in Lake Poso.

Other *Tylomelania* species live well camouflaged in the leaf litter.

are spread over large regions of the tropics. The "thick-lipped" (from the Greek, pachy = thick, chilus = lip) snails were named for the often heavily thickened edges of their shells. Aquarists also know other species from this family, for example, *Faunus* and the numerous *Brotia* species. However, these are only conditionally suitable for aquarium keeping, as they are quite specialized in terms of their reproduction.

The original forms of the modern Pachychilidae must have already existed at the time of the ancient supercontinent Gondwana, since the extant species inhabit all its former parts (Central and South America, Africa, Madagascar, and Australia).

Tylomelania, endemic to Sulawesi, have developed a very special reproductive strategy: they are ovoviviparous. One offspring, surrounded by an egg case, is nourished within the uterus of the parent by secretion. When the young animal hatches from the egg, it is fully developed and enters the world with an already hardened shell. Some *Tylomelania* species bear juveniles of almost 0.8 inch (2 cm) total length. This is a record for snails.

When a young animal is born, another egg is immediately released from the fallopian tube into the uterus. This is only possible because the environment in their tropical habitat hardly changes. There are no seasons that might affect the successful propagation by altering external factors. Therefore, when keeping them in the aquarium, stable conditions are vital.

Aquarium care

Generally, these large snails are not difficult to maintain. Some people keep them in a 3-gallon (11-L) nano tank. The smaller-growing species—some are only about 0.4 inch (1 cm) in size, but are rarely imported—may indeed do well in such a setup, but a snail with a shell up to 4 inches (10 cm) long needs an aquarium at least 24 inches (60 cm) long, preferably bigger. In nature, *Tylomelania* are highly adapted to their habitat and graze on detritus and algae on wood or stones, or they live on sand, which they chew and sift for food. You will notice very quickly where your snails prefer to hang out in the tank.

Fortunately, these mollusks are not picky and accept any kind of conventional dry or flake food. In addition, you can offer them cooked squash, carrots, or lettuce. Not all species eat the same food, so you might have to experiment a bit. The aquarium may be densely planted, because *Tylomelania*—at least in my experience—do not touch higher plants.

These snails are mostly purchased in order to keep together with Sulawesi shrimps from the large lakes. However, the imported *Tylomelania* are not always from the lakes themselves, but are often collected in the cooler tributaries. Some importers do a temperature test by adding one animal to warmer water and one to cooler water and checking to see which one comes out sooner. The correct temperature will make the snail poke its head from the shell and begin to graze.

If the snails feed and feel well, sooner or later offspring will appear. The parents do not care for the babies, and soon you will see all sizes of snails climbing peacefully all over the aquarium substrates, rocks, and wood.

Habitats

The snails of the genus *Tylomelania* live in the large lakes of central Sulawesi, as well as in the many tributaries and outlets of these lakes. Various species are imported regularly from the Malili lakes, especially Lake Towuti

Right, top: Slowly but steadily, an approximately 4-inch (10-cm) *Tylomelania* cf. *kuli* glides along the floor of Lake Poso.

Bottom: These tiny *Protancylus* cf. *pileolus* have attached themselves to a big *Tylomelania* cf. *kuli*.

Left: A large *Tylomelania* cf. *kuli* in the aquarium. The nicely patterned mantle and the 4-inch-long (10-cm) shell make this snail a very interesting occupant for the aquarium.

Below, left: The shell of this *Tylomelania* sp. from Lake Poso is coated with a layer of calcareous deposits. Even the attached limpet-like *Protancylus* cf. *pileolus* are covered.

and Lake Matano, and their surrounding rivers. Years ago the first species came mainly from the Malili drainage, but more recently some have arrived from Lake Poso in the northwest.

First and foremost in numbers imported is the orange *Tylomelania* sp. from Lake Poso (see cover images). Quite a few aquarists maintain and breed them. This medium-sized species, distinguished by its beautiful orange mantle, comes from the lake itself and requires permanently higher water temperatures. However, in the tributaries I also found a nice similar form that must be kept cool and quickly perishes in high water temperatures.

Especially in the large lakes, in the course of evolution many species developed from one or even several archetypes. This process is called radiation or speciation into several niches and is still in full swing, so it is sometimes difficult to differentiate the species from each other. For example, if you dive into Lake Matano, you immedi-

In the aquarium, *Tylomelania* cf. *centaurus* is easy to care for and reproduces without problems.

Many *Tylomelania* we collected from Lake Poso were carrying small red parasites on their mantles.

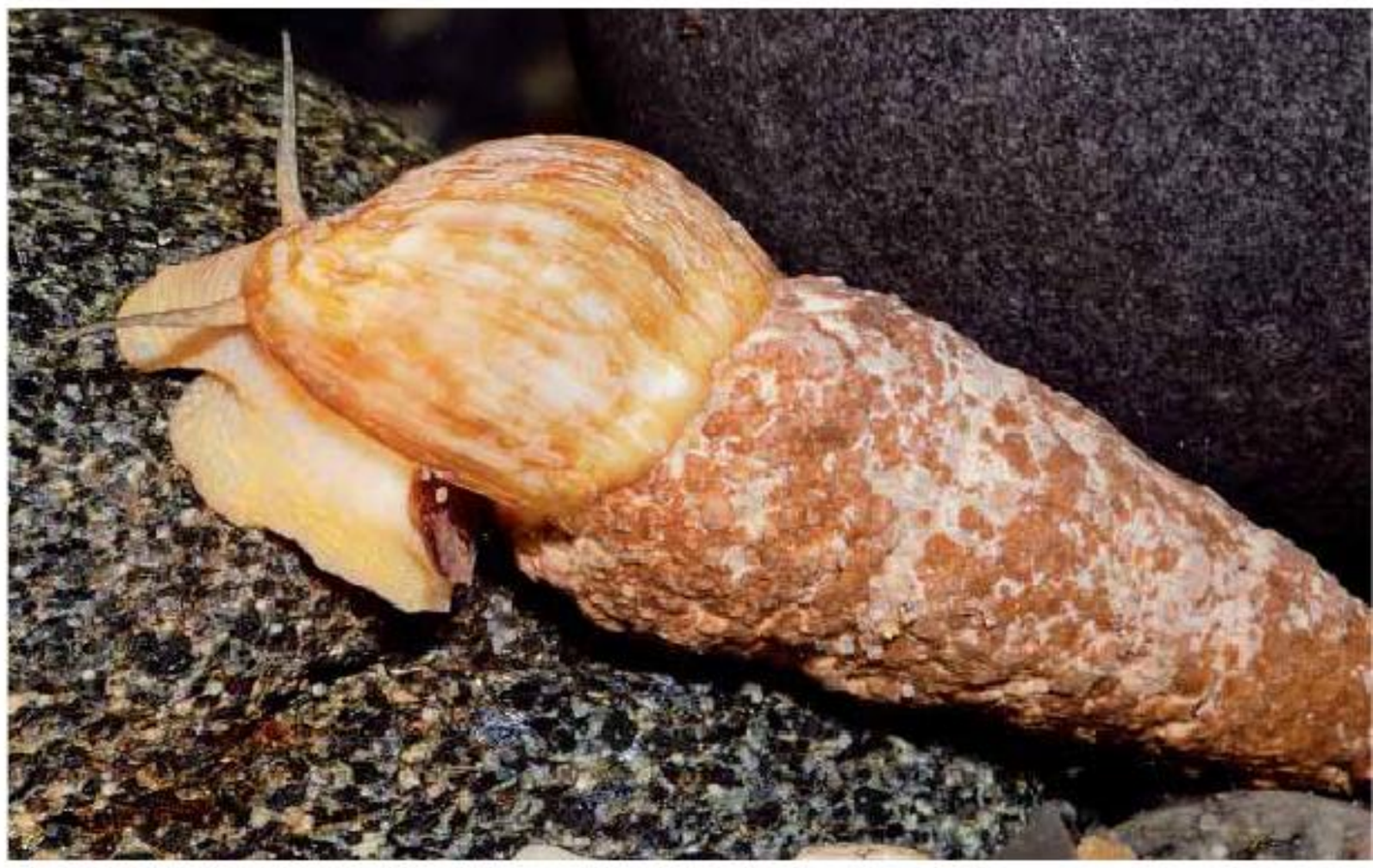
ately notice the numerous *Tylomelania* sitting on wood or stones. The slight differences in the body color and shell shape are only discernible with closer inspection. But in Lake Poso, I was able to clearly distinguish between the various forms that I found in different habitats.

This radiation has always been accompanied by an extreme adaptation to a particular habitat. A rather large species with a shell length of about 4 inches (10 cm) and a yellow and black striped mantle is observed only on vast sandy areas. The shells are colored brown-black underneath and the tops are covered with a sand-colored calcareous deposit. When in danger, these large snails bury themselves half into the sand and are then well camouflaged. They are covered with little snails of the genus *Protancylus*, endemic on Sulawesi, who "abuse" their larger cousins as substrate. They resemble marine limpets (Patellidae) but belong to the Planorbidae (ramshorn snails). I rarely found the 0.4 inch (1 cm) livebearing *Protancylus* cf. *pileolus* on other *Tylomelania* species on wood or stones, even in the immediate vicinity.

Other species are found only on the dead wood abundant on steep banks. They seem to feed on detritus and the sparse algae growth. Still other species I found only on rocks and boulders in the previously mentioned lakes. In some places in Lake Matano, *Tylomelania* are so common that I could count at least 68 individuals in a marked area of 10 square feet (1 m^2). I staked out the area arbitrarily and then collected the snails the next day, so as not to succumb to the temptation to choose a densely occupied area and bias the result.

Such a population density, of course, raises the question of nutrition. The lakes are oligotrophic and therefore provide only a few nutrients to grow algae. However, the populations of shrimps and snails in some places are enormous. Who is benefiting from whom? Do the snails eat the abundant shrimp excrement? Near the banks where there are dense stands of trees, falling branches and leaves certainly provide enough nutrients. So it is no wonder that certain species of *Tylomelania* are frequently found on decomposing leaves. This behavior is also noticeable in the cooler streams at higher elevations. I found these *Tylomelania* near Lake Poso and the Matano and Towuti Lakes, as well as much further south in the southeastern part of Sulawesi near the city of Kendari.

Below: This pretty *Tylomelania* sp. from Lake Towuti is partially covered with calcareous deposits. It needs to be kept warm!



From the surrounding rivers of Lake Towuti come these so-called "Thunderbolt *Tylomelania*." They need to be kept cool! The shells are covered by a thick layer of calcareous deposits, which dissolve quickly when kept in soft water.

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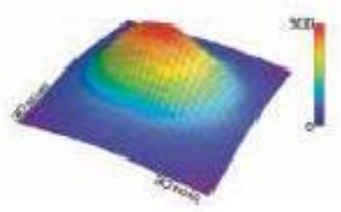

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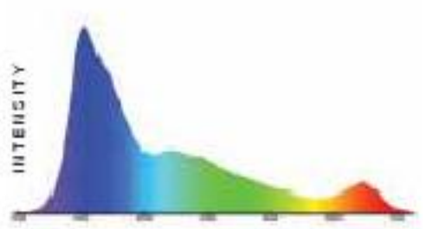

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These animals are commercially available as "Thunderbolt *Tylomelania*." Due to the high mineral content of the water, their shells are often covered with calcareous deposits. The layers can be carefully removed to reveal a pretty spiral shell underneath. I found these snails regularly in the sinter (siliceous) terraces below waterfalls, for instance the well-known Saluopa Waterfalls northeast of Lake Poso and the Sumbersari Terraces near Kendari. Large numbers of these snails are found in quiet zones with dense leaf litter.

Surprising diversity

I could write page after page on the habitats of the species of *Tylomelania*. There are some new stories about these snails, such as the report that the tiny Zebra Sulawesi Goby, *Mugilogobius adeia,* in Lake Matano uses the empty shells as spawning caves, similar to the shell dwellers of Lake Tanganyika that use the empty shells of *Neothauma*. *Tylomelania* are certainly still full of surprises. The genus has only been partially explored and offers an incredibly exciting field of study, especially in terms of speciation.

The birth of a baby *Tylomelania* sp. The young are born with a hardened shell. This is only possible because a thick layer of mucus, seen here as an appendage on the young animal, facilitates the birth.

The observant reader will have noticed that I have refrained from talking about the scientific names. Well over 30 different species have been described from these habitats (Rintelen & Glaubrecht, 2005), and probably many more are waiting for their scientific description. I want to avoid the possibility of the wrong species names becoming established, and therefore I usually avoid labeling them on the species level, although in a few cases, I decided to attempt species identification.

More important is to understand how extremely variable this fascinating mollusk genus is and how the species differ in their requirements. On my future trips to Sulawesi I am going to keep an eye on these slow fellows who laboriously make their way through the beautiful underwater landscapes of my dream island.

Acknowledgments

I want to thank my companion, Jeffrey Christian, for his continued support in the field. Maike Wilstermann-Hildebrand has critically examined my manuscript, kindly commented, and called my attention to the genus Protancylus.

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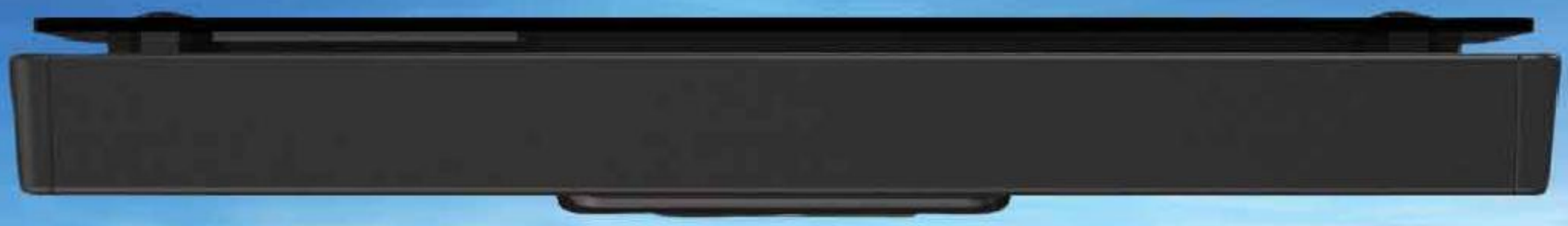

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GIANTS OF THE AMAZON:

the Arapaima

article by Marc Puigcerver and Angel Canovas; images by Angel Canovas • *Arapaima gigas*, one of the largest freshwater fishes in the world, inhabits the basins of the Amazon and the Essequibo Rivers and can reach a length of 10 feet (3 m) and a weight of 440 pounds (200 kg). Because of the delicious taste of its meat, it has traditionally been one of the most important food fishes of Amazonia. Unfortunately, stocks have declined greatly.

Most Arapaimas inhabit lakes, but they can also be found in rivers and, during the low-water season between September and January, in the interconnecting channels. During this time, the animals spawn. They migrate through the channels from one lake to another, looking for suitable spawning grounds. They usually prefer shallow seasonal waters, known as *resaca*, that often completely disappear in the dry season. Rarely, the fish remain in permanent waters and channels known as *paraná*, which cross the *varzea*, the periodically flooded areas that connect the rivers.

In general, the spawning areas are shallow waters

In this portrait, the structure of the bone plates on the top of the head can be seen.

A flooded forest, or *igapó*, during the high-water season, central Amazon River, Brazil.

with low currents. The shallow depth allows people to catch the fish, but also allows the fish to quickly reach the surface to breathe. In this way, they reduce the risk that their offspring will be eaten by other fishes when they go up for air. Furthermore, the fry can easily get to the surface during the critical phase in which they switch to using their swim bladders for breathing air.

Nest building

A round, flat nest is dug into the sand at a depth of just 3–5 feet (1–1.5 m). Depending on the size of the parents, a pair digs a nest 8–28 inches (20–70 cm) wide and up to 4.7 inches (12 cm) deep. The animals take three to five days to build the nest. They also clear an area of approximately 6.5 feet (2 m) around the nest, removing anything that predators could hide in. By removing all the oxygen-consuming organic litter, they probably also improve the oxygen supply to the fry. The nests are usually far away from floating vegetation. Even at high density, there are only one or two nests per 0.6 mile (1 km) of shoreline.

The pair spawns immediately after completing the nest. In the depression of the nest, the eggs are protected

from currents and predators. Five days after spawning, the young, perhaps numbering 1,000 or more, hatch. Now the female disappears and sometimes even spawns with another male in the same season.

The male protects the fry by staying close, not moving farther away than 39 inches (1 m). For three months, he leads the fry through the flooded forests, where they feed on insects and fish larvae. In this habitat, the low density of predators and the abundance of food ensure that a large number of young fish grow up. The areas of floating islands are especially ideal habitat for the growing fry. They grow up fast: after three months they are already 12–20 inches (30–50 cm) long.

When the water begins to recede from the flooded forest, the male leaves the offspring, and they spread through the channels in search of permanent waters, such as lakes. The juveniles avoid unsuitable habitats. They change constantly between *chavascal,* or *igapó*, *rest-inga* (wooded sandbanks, named high or low, depending on the height and age of the vegetation), *paraná, cano* (temporary connections between lakes and other bodies of water), and the river itself.

Arapaimas for Sale

Arapaima gigas has been listed on CITES Appendix II since 1975, so CITES documentation is required for export of this species from its country of origin. In addition, importation to the United States requires a permit under 50 CFR (Code of Federal Regulations) Part 23. Although *A. gigas* occurs in Peru, Colombia, Brazil, and Guyana, apparently only Colombia has applied for CITES quotas in living memory. Colombia granted permits for the export of 5,000 live specimens in 1997, 1998, and 1999. No more recent quotas are listed by the CITES authorities. (See www.cites.org/eng/resources/species.html.)

The Lacey Act, 16 U.S.C. §§ 3371–3378, prohibits trade in wildlife, fishes, and plants that have been illegally taken, possessed, transported, or sold in violation of any law, treaty, or regulation of the United States, thus bolstering other federal, state, and foreign laws that protect wildlife by making it a separate offense to take, possess, transport, or sell wildlife that has been knowingly taken in violation of those laws. By the extension of the Lacey Act to treaties like CITES, non–CITES-documented *A. gigas* specimens cannot legally be owned, traded, or moved within the U.S. (See www.animallaw.info/statutes/stusfd16usca3371.htm.)

Even so, *Arapaima* specimens can be found without much difficulty in the North American aquarium trade. For example, Ocean State Aquatics in Coventry, Rhode Island, sells *Arapaima gigas* juveniles at its store and on the Internet on the Monster Fish Keepers site. A spokesman for the shop says in an online video that the fish are "all farm-raised in Peru."

The bottom line: It is probably illegal to possess any *Arapaima* you might acquire, unless the seller can furnish you with a copy of a CITES certificate. Check with your state laws as well, because several states prohibit the import of *A. gigas*. This fish also demands expert care, live foods to survive as a juvenile, heavy feeding, scrupulous attention to water quality, and an immense aquarium or pond. Peruvian fish farmers stock *Arapaima gigas* at just one fish per 3,230 square feet (300 square meters).

—Stephan M. Tanner, Ph.D.

Migration of the juveniles

During the high-water season on the upper Amazon—from January to April—one can find Arapaimas in the flooded forests of the *chavascal* or *igapó* (in Brazil) and along the high and low *restinga*. Because they are able to breathe air, they can survive the low oxygen content of these habitats. With their elongated bodies, they are also well adapted to these shallow waters. The fish prefer water under 10 feet (3 m) deep and low currents so they can conserve energy.

At the age of one year, Arapaimas feed mainly on fishes and therefore forage in freshly flooded habitats, where

The red scales (shown below, left) on the rear third of the body prompted the native name for this fish, Pirarucú. Juvenile *Arapaima gigas* such as the one pictured below do not show the red color of adult animals.

there are many small fishes—especially the well-known aquarium catfishes of the families Callichthyidae, Loricariidae, Pimelodidae, and Heptapteridae. The species of the first two families can also survive in this oxygen-poor habitat because they are equipped with bowel breathing.

During the low-water season, Arapaimas are mainly found in lakes. When the water level drops, the populations of their prey fishes become denser. Many of these fishes perish due to high temperatures of 81–88°F (27–31°C), low oxygen concentrations, and poor water quality. For the Arapaimas, this is a feast. Here they meet their partners, perform courtship, and then, toward the

Large Arapaimas are an eye-catcher in any show aquarium.

end of the dry season, migrate to the places where they will spawn.

Critically endangered

Due to the decline of their stocks, the Brazilian government has regulated the catch of the Arapaimas, or Pirarucús (the Indian word *pira* stands for fish and *uruçu* is the Indian name for Achiote, *Bixa orelliana*, whose seeds supply the red pigment for body painting). Brazil introduced a minimum size limit for the fish caught, prohibited fishing during the spawning season, and even imposed a fishing moratorium for the state of Amazonas. However, because of widespread illegal fishing and the lack of effective controls over the vast territory, these measures are far from adequate.

The Arapaima is mainly threatened by spear fishing; since they must come to the surface to breathe every 15 minutes, they are easily killed by experienced fishermen. During the spawning season, the animals are particularly vulnerable. They create their nests in shallow water and are easy to spot, despite the cloudiness of the water during this time. The males are also at risk during brood care.

Arapaima gigas has now completely disappeared from the waters in the vicinity of cities and settlements. Overexploited in the rest of the Amazon basin, the species is considered endangered to critically endangered. The only somewhat successful measures are those that protect the habitats of the Arapaima and restrict the fishing season. Concerned observers are calling for new protections for their spawning areas as well as the flooded forest areas when the fish are most vulnerable.

Arapaima gigas taking air at the water's surface.

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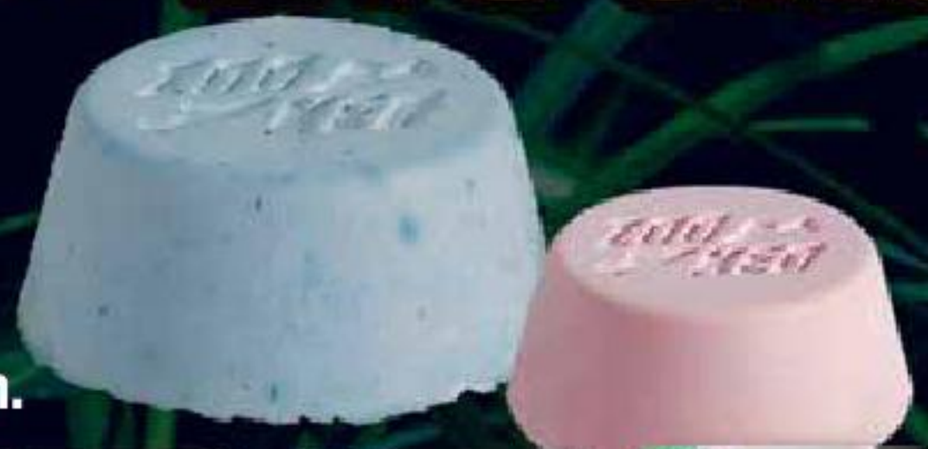

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from wild type to the "Full Blue Rili"

Neocaridina heteropoda

article by Gerd Arndt; images by Hans-Georg Evers • The various captive-bred forms of *Neocaridina heteropoda* are very popular with "cherry shrimp" fanciers, who are often baffled by the names and histories of the many different strains. Here we trace how the Sakura strain has emerged from the Taiwan wild type and look at what is going on with the "Jelly Blue" strain.

Steffen, a friend and professional breeder, visited me to pick up some breeder tanks with gauze bottoms for his *Cambarellus patzcuarensis* Orange and Crystal Red shrimps. On that occasion, he brought along offspring of a wild-type strain of *Neocaridina heteropoda*. He handed me the bag of shrimp with these words: "I received these animals from Friedrich Bitter, who brought them back from Taiwan. They occasionally produce red individuals, from which the Sakura supposedly originated."

Wild-type strain from Taiwan

Steffen had selected the darkest animals. Females showing a dorsal stripe were the most intensely colored animals. They were almost completely black, but with a more or less distinct blue tone. The males' pigmentation was much fainter. They had black and brown vertical stripes on a transparent background, which did not look particularly attractive. Steffen told me that the demand for these animals was not very high, but as killifish food they were first class!

The animals were very productive, like almost every *Neocaridina heteropoda* variety. However, it took about three months until I discovered the first two red shrimp. Of course, they were both females. After half a year, I had a total of five red shrimp. The three females were solid red, while the two red males showed a vertically striped pattern. These animals formed the basis for further breeding.

The females of the F_1 offspring were indeed red, similar to the Sakura, but the color was more

This is how my Sakura males look today.

Above, left: Dark colored female of the wild type *Neocaridina heteropoda.*

Above, right: Female of the dark brown Taiwan wild type.

Right: Red Sakura female derived from the Taiwan wild type of *Neocaridina heteropoda*.

of a reddish brown. The males all showed vertical red to reddish brown stripes on a transparent background. Further selective breeding improved the colors significantly. The red became more intense and brilliant, and the brown tinge disappeared. In the course of further breeding, even the color of the males improved. They lost the striped pattern and became as solid red as the females. Of course, there were always some males who still showed a striped pattern.

My home-bred Sakuras and the Sakura imports from Asia shared two similarities: Among the offspring of both strains, females emerged with a brighter and pale translucent red coloration, males with a dark vertical stripe pattern. In the Asian strain, the proportion of these animals was approximately 5 percent. In the strain that I had selected, the percentage was much higher. This might have been due to the fact that my strain had not been selectively bred for as long as the Asian strain, and therefore may not have been as stable. I also noticed another commonality: the offspring never produced animals with the wild-type pigmentation.

Later, backcrossing of a red female with a wild-type male produced only brown offspring. The red animals are therefore pigment-deficient mutants of the wild type. The red color is inherited recessively, while the wild type is dominant. I am now convinced that the Sakura strain was selectively bred from the Taiwan wild-type shrimp.

Sakura: the first strain

I received the first Sakura strain several years ago from a fellow breeder. They were the offspring of the first animals imported to Germany. They were significantly more colorful than the Red Cherry strain, and even the juvenile shrimp were distinctly red in contrast to Red Cherry babies.

Among the offspring there were some females and a few males that showed a solid red color. The proportion of these animals was about 20 percent. The remaining animals were all nicely red but had small colorless patches on the abdominal and carapace areas. In the males, there were variations in the patterns. Some males had a more or less wide vertical striping pattern on a transparent

Right: The first Sakura males that originated from the wild type still showed a red stripe pattern. Today, even the males of this form are completely red because of rigorous selection.

Top: Imports of Taiwan Sakura show a beautifully bright red color. My strain has also achieved this level of pigmentation.

Bottom: Rigorous selection and carotene-rich food resulted in my orange Sakura strain, which has a stable, intense orange base color.

background. The stripes of these animals showed a darker red than the red of the other animals. The rest of the males looked similar to the females of the Red Cherry, with colorless spots on the abdomen and carapace.

In the course of further selective breeding the number of Sakura (solid red animals) became greater. A dark opaque red covered the whole body. Egg-bearing females could only be identified by their corpulence, because the opaque red color of the abdomen concealed the eggs. After years of selecting, the proportion of solid red animals is now at about 90 percent, and I am quite pleased.

Soon individual orange animals emerged, but also red animals that met the "Rili" criteria with a translucent midsection. I maintained these "false color" variants further. The orange Sakura was a xanthochromistic form, inherited recessively, and thus genetically stable. However, the red "Rili" was different. Here, the path to genetically stable animals was significantly longer.

It is noteworthy that after breeding thousands of offspring, I have never encountered a single black-brown wild-type animal among the original Sakura, orange Sakura, or red "Rili" strains.

Initially, I was unhappy with my Sakura because the photos on the Internet always showed animals with solid red colors. No individuals were ever shown that had the color pattern of the Red Cherry, as did most of my offspring. At the time, there were no Sakura available in the pet shops yet, so I attended different fish auctions and invertebrate meetings. It was in vain; the animals exhibited or offered for sale as Sakura all looked like my offspring. Some were even worse than mine.

Then the first offspring of some breeders appeared on the Internet. Most of the offerings were accompanied by photos. But even on the Internet, these so-called Sakura were just nicely colored Red Cherry shrimp. But when a seller offered imports from Asia, the photo showed a Sakura. Hence, real Sakura were only available from Asia at the time.

The proportion of female offspring was approximately 70 percent in all my *Neocaridina heteropoda* strains,

Right: Some of my "Full Blue Rili" animals still have rust-colored spots on the body.

My female "Blue Rilis" carry blue-green eggs.

"Jelly Blue" animals imported from Asia. They were probably developed from the Sakura strain as well, because there are occasionally individuals with rusty dark spots on the body.

A few of the "Blue Rili" females carry yellow eggs.

whether they were wild forms or color varieties. Among my 200 Sakura import animals there were just six males, and they were barely recognizable as males, because they were colored like females.

Since the male *Neocaridina heteropoda* captive-breds are generally less well colored and the Sakura undergo additional color selection by their Asian breeders, not many are exported.

I suspect the Red Cherry males were crossed into the first Sakura imports. This may have been because the Sakura strain was not as genetically stable yet or because few or no males were exported due to color selection. Perhaps the males were also screened out to maintain exclusivity as long as possible for this prolific shrimp.

Sunkist

I was pleasantly surprised when I first encountered the Sunkist strain, an orange Sakura from Asia. I did not expect such an intensity of color; my own orange strain, selected from the original Sakura animals I had received from a breeder, was yellow-orange and slightly translucent. The Asian Sunkist animals were bright orange-red.

I received 80 of these beautiful shrimp from Asia. They were all already 0.9–1.0 inch (2.2–2.5 cm) long, and most females carried eggs. Most animals had an opaque, bright orange-red color. Some animals showed an opaque yellow-orange. By contrast, the only two males among them were more yellow-brown.

However, the color of the offspring was a surprise. Reminder: most females already carried eggs when I received them, so they were an original Asian strain. The colors of the offspring varied from transparent yellow to yellow-orange, bright orange-red, light red to light brown. The absolute highlights among the approximately 400 offspring were a green male and a black female that was already carrying eggs when I found her.

I moved the green male and the black female together into their own tank. The color of the offspring was not really a surprise for me—more a confirmation. There were five green animals, two yellow-orange, and the rest were divided evenly into bright orange-red and black shrimp. The black offspring suggests that the Sunkist strain is derived from the Sakura and is thus the Taiwan wild type.

"Full Blue Rili"

In the "Rili" strain, the red is interrupted by a whitish/transparent stripe. I actually had ordered "Rili" from

Asia, because I wanted to introduce new blood into my own "Rili" strain. But before crossing the Asian "Rili" into my strain, I wanted to wait for the first offspring to make sure I made no mistakes.

I received 80 beautifully colored "Rili" animals. Unlike with the Sakura and the Sunkist imports, there was an ample number of males among the "Rili." The animals had a size of 0.8–1.0 inch (2–2.5 cm) and almost all females carried eggs. After my experiences with the Sunkist, I was looking forward to the offspring, and I was not disappointed!

The strain was very prolific and the 80 shrimp quickly turned into several hundred animals. As in the original animals, many F1 "Rili" showed a bright red color. However, there were animals in which the red color was darker and more towards black. Under favorable light, these "Rili" usually had a more or less distinct hue of blue in the transparent midsection. This blue tint was also present in some red animals. I therefore called these animals "Blue Rili."

Among the females it was easy to recognize the "Blue Rili" because they carried a blue to blue-green egg spot. Later, the eggs also showed these colors. In the male sex, the "Blue Rilis" were mostly those animals with a darker red color. In the course of breeding, I realized that the red parts of the body in the offspring were becoming smaller and smaller. Thus, red Sakura had to be crossed in, since the "Blue Rili" never produced fully red animals that I could cross back to.

The strain was now almost stable. The offspring were divided into "Red Rili," "Blue Rili," and some black-brown wild-type specimens with a more or less distinct blue tinge. The continuous breeding had shown that the wild type was responsible for the light blue color of the "Blue Rili."

Then, among the offspring, the first "Full Blue Rili" appeared, which showed a bright, translucent blue on the entire body. Some of the animals still showed a small red spot on the head.

Such light blue shrimps were imported from Asia and sold as "Jelly Blue." I had hitherto believed that it was an intensely colored "Blue Pearl" strain, but I was proved wrong when I purchased some of these animals. They were clearly "Full Blue Rili," since two of the shrimps still had the typical red spot on the head. Since these animals produced some Taiwan wild types among their offspring, I assume that they were also derived from this wild form.

The "Rili" that descended from my first Sakura strain were all red "Rili" without a blue tinge. They were the result of the fact that I transferred all excess animals from the breeding tanks into a large aquarium and offered them for sale. Of course, these animals also reproduced, but without selection.

From my experience with breeding Guppies, I knew that under such conditions animals regress to the original form. That happened also with the Sakura. They started in the middle of the body with translucent colorless stripes that became wider and wider, until only the head and tail regions showed any red color. Later there were also translucent shrimp, including some that looked like wild type "Red Fire" males. If these transparent shrimp had not had a blue tint, they would have been "Jelly Blues." But the way they were, they looked rather plain and not very appealing.

Among the "Rili" offspring from my first Sakura strain, I never found an animal with the wild-type color. However, since there were individual transparent animals that corresponded to the Red Fire wild type, it suggests that Red Cherry or Red Fire animals had been crossed in.

This red "Rili" shrimp resulted from my Sakura strain.

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Genus *Tanichthys*

White Clouds, Meteor Minnows, and Sparkling Gems

article and images by Paul V. Loiselle, Ph.D. • Few ornamental fishes have made a successful aquarium debut so soon after their scientific description as *Tanichthys albonubes*. The type series of this colorful little minnow was collected in 1932 from streams draining Bai Yun Shan—White Cloud Mountain—in China's Guangdong Province by Tan Kam Fei, a scoutmaster with a keen interest in the flora and fauna of his native region. In appreciation of his efforts, the Chinese ichthyologist S.-Y. Lin later in the same year erected the genus *Tanichthys* for this diminutive and morphologically distinctive cyprinid, whose species name, *albonubes* (= white cloud), refers to the type locality. The White Cloud Mountain fish was enthusiastically welcomed by the members of Cathay Aquarists, a local aquarium society based in the city of Guangzhou—more familiarly known to Westerners as Canton—as well as by their counterparts in the Hong Kong Aquarium Society.

Above: A mature male Meteor Minnow. The extensive zone of red along the lower posterior portion of its body indicates that this long-finned variant of *T. albonubes* also carries the genes of the so-called "Super Red" White Cloud. Their fin coloration suggests that Meteor Minnows are derived from the Hong Kong population.

The first White Clouds, to give *T. albonubes* the common name by which it is known today, were brought to North America in 1935 by a young hobbyist, C.W. Brownell, who passed them on to O.R. Eastman, a Montreal-based aquarist. Eastman's efforts to breed the fish enjoyed only a modest degree of success. Although his four wild-caught fish spawned repeatedly, he was able to rear just two males and a single female to maturity. Realizing his own limitations, in 1936 he passed the surviving pair of White Clouds on to William T. Innes of Philadelphia in the hope that the efforts of this noted American aquarist would prove more productive.

Innes was able to both repay Eastman's generosity by sending him a new batch of fish and place brood-stock into the hands of several commercial fish breeders. *Tanichthys albonubes* was formally introduced to American hobbyists (Eastman, 1938; Innes, 1938) in the pages of the September 1938 issue of Innes's magazine, *The Aquarium*, which also carried advertisements for "the Chinese wonder fish" by dealers based in Philadelphia, St. Louis,

and San Francisco. At an asking price of $2.00 each, roughly a day's wage for a Depression-era factory worker, one wonders how many of these fish found buyers!

The first shipment of White Clouds to Europe was made from Hong Kong in 1937 (Sugars, 1938). Only a dozen of the 2,000 fish in the shipment were still alive when the P & O steamer carrying them docked in England. Although the fish were transported in aerated tanks, most fell victim to the extreme temperatures the ship encountered as it passed through equatorial waters. Presumably these heavy losses dictated the fishes' asking price of 50 shillings each. As this sum was close to a week's wages for a skilled worker in the United Kingdom at the time, one also wonders how quickly the British importer found purchasers for his fish. It is a testimony to both the fecundity of *T. albonubes* and the ease with which it can be bred that within a decade of its initial importation to both North America and Europe, the "Chinese wonder fish" was being promoted as "the poor man's Neon Tetra"!

The color plate that graced the cover of the September 1938 issue of *The Aquarium* depicts a group of White Clouds descended from the wild-caught founders Brownell brought back from China. Their dorsal fins, like those of the population originally described by Lin, have red bases, while their clear yellow anal fins are edged in iridescent white (Figures 1 and 2). In his account of the Hong Kong population of *T. albonubes*, Sugars (1938) describes a fish in which both the dorsal and anal fins sport a red marginal zone.

Hong Kong White Clouds were subsequently exported to San Francisco, where the American ichthyologist Albert Herre encountered them. The color pattern differences between the topotypical and Hong Kong populations led him to suspect that these two color forms might actually be different species. Herre's suspicions were apparently confirmed when, in 1939, Lin sent him a manuscript that included the description of a new small cyprinid from Hong Kong. Herre (1939), under the twin assumptions that the manuscript had already been published (it hadn't) and that Lin was proposing a new name for the Hong Kong White Cloud, *Aphyocypris pooni* (he wasn't), utilized this name for the Hong Kong fish in a popular article that appeared in advance of Lin's paper. Herre's description of *A. pooni* was sufficiently detailed to satisfy the publication criteria for a species description set forth in the International Code of Zoological Nomenclature, thus assuring this name's taxonomic validity.

Were they both talking about the same fish, Herre would have done nothing more than inadvertently "scoop" Lin. However, the animal Lin described as *A. pooni* was a very different fish from the Hong Kong population of *T. albonubes*. This state of affairs would have been of little concern save to the relatively small number of ichthyologists working with Chinese fishes, but for two unrelated developments. First of all, aquarists discovered that the "classical" *T. albonubes* illustrated by Innes and the Hong Kong fish, *Aphyocypris pooni sensu* Herre, interbred freely, producing viable and fully fertile offspring of both phenotypes. This led Innes (1945) to conclude, quite

Figure 1. A male of the topotypical population of *Tanichthys albonubes*. Its common name notwithstanding, this species can no longer be found in the streams draining White Cloud Mountain.

Figure 2. Female White Clouds descended from this population are more full-bodied than males, have less pronounced white edging to their dorsal and anal fins, and show less red coloration in their anal and ventral fins.

correctly, that the two phenotypes in question simply represented geographical races of the same species. What complicated the picture and led to almost two decades of confusion was the entry of the fish described by Lin as *Aphyocypris pooni* into the aquarium trade. The Garnet Minnow—this fish's generally accepted common name—looks nothing at all like the Hong Kong White Cloud. In consequence, publications purporting to distinguish between *T. albonubes* and *A. pooni*, as exemplified by the account in Sterba (1962), have something of the flavor of the Indian parable about six blind men describing an elephant.

Resolution of this situation came with the publication in 1966 of a definitive paper by S.M. Weitzman and L.L. Chan. After examining relevant type material, they concluded that, as the two descriptions clearly do not refer to the same animal, Lin's name is a junior homonym of Herre's. Furthermore, they determined that Herre's *A. pooni* was morphologically indistinguishable from *T. albonubes* and thus a junior synonym of that species, while *Aphyocypris pooni* Lin 1939 was referable to the genus *Hemigrammocypris* and thus did not merit separate generic status. Under the provisions of the Code, the name *pooni* was no longer available for Lin's species, so they proposed *Hemigrammocypris lini* as a replacement name for the Garnet Minnow. Although Weitzman and Chan's paper should have put to rest any doubts about the taxonomic status of the Hong Kong population of the White Cloud, the use of the cheironyms *Tanichthys linni* or *Tanichthys albonubes* var. *linni* for these fish on wholesalers' price lists, as well as on some web sites, suggests that is not the case.

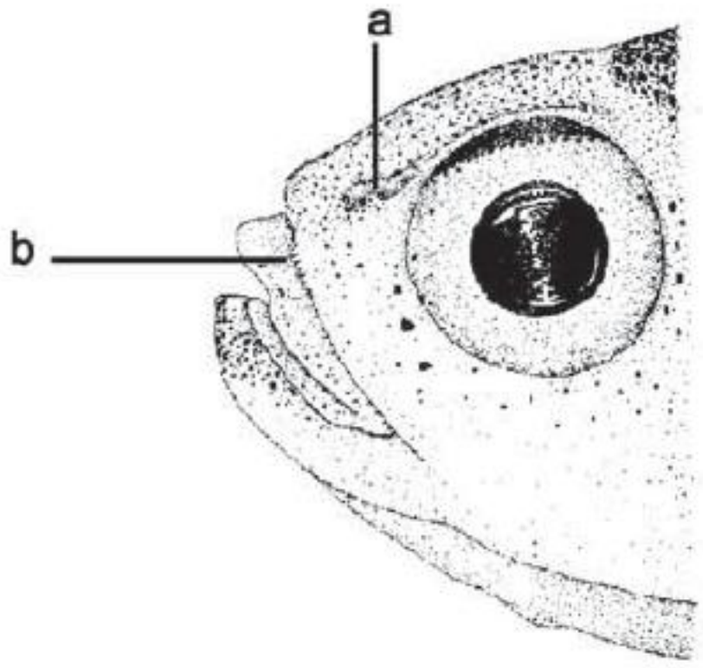

Figure 3. This drawing, taken from Weitzman and Chan's 1966 paper, clearly shows the single opening shared by the paired nostrils on each side of the head as well the row of small, horny tubercles along the side of the upper jaw. These two features set *Tanichthys* apart from all other representatives of the family Cyprinidae known at that time.

Figure 4. A spawning pair of Japanese bitterlings, *Rhodeus ocellatus*, approaching their intended spawning site, a freshwater mussel. Although these representatives of the subfamily Acheilognathinae differ greatly from *Tanichthys* with regard to morphology, color pattern, and reproductive biology, genetic data suggest that they are closely related.

Figure 5. Recent genetic studies also group the Eurasian Tench, *Tinca tinca*, another anomalous cyprinid species, with *Tanichthys*.

Weitzman and Chan also took a stab at determining to which of the several recognized cyprinid subfamilies the White Cloud belonged. In this endeavor they were less successful. Upon careful examination, they were able to identify two unique anatomical features that unambiguously defined the genus *Tanichthys* and set it apart from all other representatives of the enormous family Cyprinidae known to them. In the White Cloud, the two nostrils on either side of the head are not separated by a fleshy ridge but instead share a common pit-like opening, and a row of small, horny tubercles is present along the side of the upper jaw (Figure 3).

Lin had tentatively suggested that the danios were most closely related to *Tanichthys*, a notion that is still shared by many tropical fish wholesalers, who lump the two together on their price lists. Weitzman and Chan were unable to find any of the anatomical features that defined the danio lineage in the White Cloud. Nor did they find any evidence that *Tanichthys* belonged in the subfamily Leuciscinae, a large assemblage of Eurasian and North American minnows. In point of fact, the nostrils of representatives of the diminutive West African genus *Barboides* also open into a common pit, but these fishes,

representatives of the subfamily Barbinae, are in all other respects quite dissimilar. The sister-group relationships of *Tanichthys* remain obscure, although more recent molecular analyses (Fang et al., 2010) suggest that the White Cloud's closest relatives are the morphologically very different bitterlings (subfamily Acheilognathinae, Figure 4) and *Tinca tinca*, the Eurasian Tench (subfamily Tincinae, Figure 5).

Since its original description, it has been assumed by ichthyologists and aquarium hobbyists alike that the genus *Tanichthys* was monotypic, comprising only a single species. The fallacy of this assumption was demonstrated by the description in 2001 of two new *Tanichthys* species. *Tanichthys micagemmae* Freyhof and Herder 2001 (Figures 6 and 7) was described from specimens collected from Bu Dong Creek, a small stream tributary to the Ben Hai River just north of the city of Dong Ha in central Vietnam. My initial reaction to the excellent color photograph accompanying the description was that *T. micagemmae* had a real future as an aquarium fish. Apparently quite a few other people—some of them in a position to do something about it—also felt that this species would be of interest to hobbyists. In a manner strikingly reminiscent of the history of *T. albonubes*, *T. micagemmae* was available from exporters in Singapore the same year it was described and made its North American aquarium debut almost immediately thereafter. This species has been marketed under the somewhat misleading name "Vietnamese White Cloud." As its locality of origin lies many miles to the south of White Cloud Mountain, I suggest that Sparkling Gem Minnow, a literal translation of its specific name, is a more appropriate name for this beautiful little fish.

The same year also saw the description of a third *Tanichthys* species, *Tanichthys thacbaensis* Nguyen and Ngo 2001 (Figures 8 and 9). As the specific name *thacbaensis* implies, the type series was collected from the basin of Thac Ba Lake, a reservoir formed by the damming of the Chay River in Vietnam's Yen Bai province. Impressed by his customers' positive response to the Sparkling Gem Minnow, my friend Frank Greco, who has a small fish import business (www.franksaquarium.com), asked me in 2010 what I could tell him about "the other Vietnamese White Cloud." I had to confess ignorance, as the species description—written in Vietnamese—was published in a hard-to-find multi-volume treatment of the freshwater fishes of Vietnam. All I could tell him was that the type locality was a long way from Vietnam's main focus of ornamental fish exportation in Saigon and relatively difficult of access. I thus felt fairly confident in predicting that aquarists would not be seeing *T. thacbaensis* any time soon.

Frank had also concurrently expressed an interest in this species to Patrick Yap, one of his suppliers. Patrick, a Singapore-based exporter, replied that as ornamental fishes were now being regularly exported from Vietnam, he felt it was only a matter of time before *T. thacbaensis* made its debut as an aquarium fish. He was right: this species made its appearance in the United States under the name Lemon White Cloud in 2011. I have since given up on predicting when—or even whether—aquarists are likely to see a newly described fish species!

Figure 6. A male Sparkling Gem Minnow, *Tanichthys micagemmae*. The solid red anal and ventral fins and the absence of this color from the dorsal fin distinguish this Vietnamese *Tanichthys* from its Chinese congener.

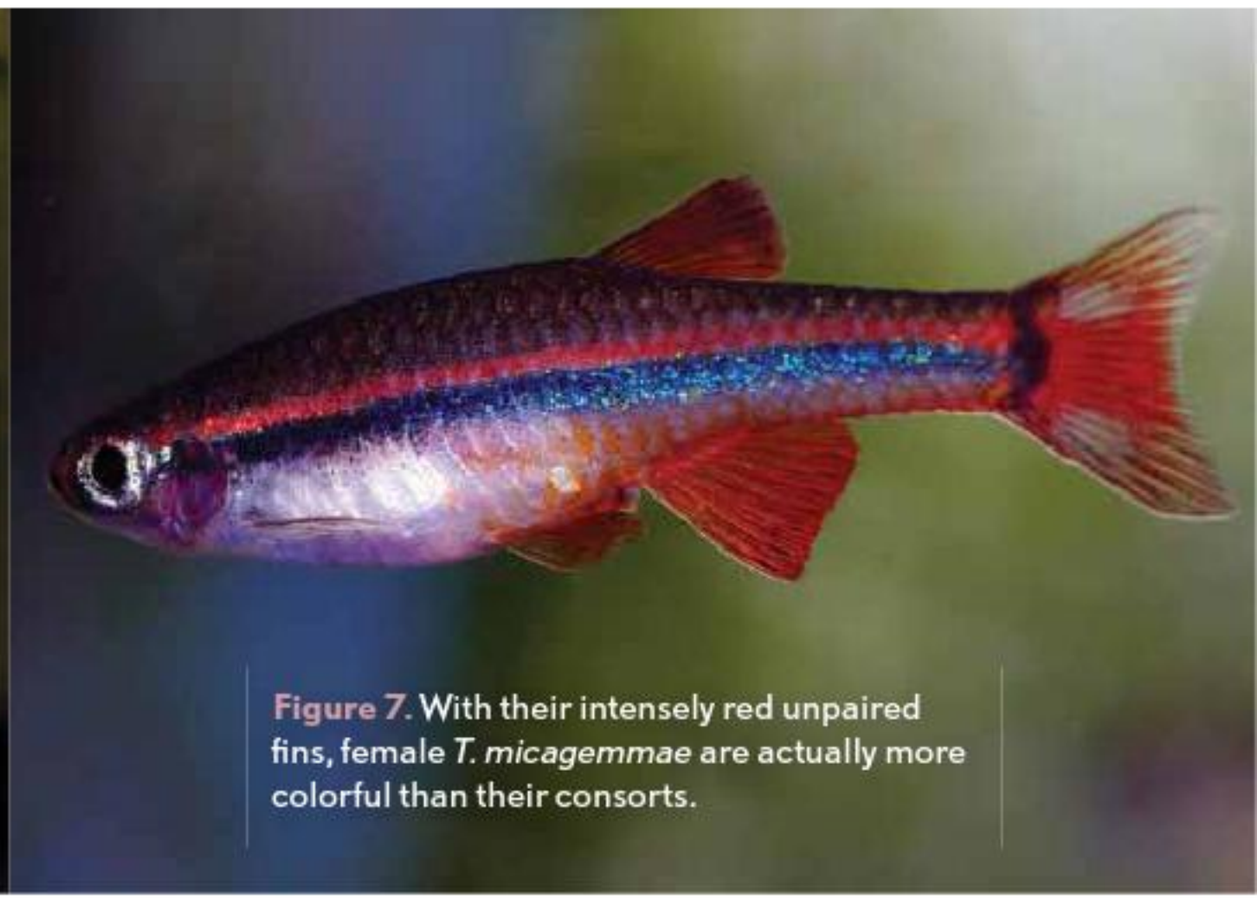

Figure 7. With their intensely red unpaired fins, female *T. micagemmae* are actually more colorful than their consorts.

Mutation happens

William T. Innes (1938) predicted that the White Cloud was destined to enjoy enormous popularity and would eventually become the Guppy of egglayers. Colorful, hardy, easily bred, and prolific, *T. albonubes* has indeed lived up to Innes's expectations. White Clouds are effectively ubiquitous in retail establishments worldwide. As is often the case when an ornamental fish is produced in huge numbers, mutant individuals have appeared that have allowed breeders to selectively breed distinctive White Cloud variants.

The first of these, a long-finned variant initially marketed as the Meteor Minnow, made its debut in the 1960s. Unlike the long-finned variants of the Rosy Barb and Serpae Tetra, in which indeterminate fin growth destroys an individual's basic symmetry and can actually impede its swimming ability, fin growth in the Meteor Minnow is determinate. The fish's basic symmetry is thus preserved (Figure 10, opening page). I am not a fan of most long-finned fish varieties, but the Meteor Minnow is always a welcome guest in my fish room. A golden form of the White Cloud with normally pigmented eyes, but otherwise devoid of black pigment, is also widely available (Figures 11 and 12). I have not been able to pinpoint the date of its introduction, but the Golden White Cloud began to make regular appearances on wholesalers' price lists in 2002. The most recent of these catatechnic color forms is the so-called Super Red White Cloud, in which the red coloration present in the caudal fin extends into the posterior third of the flanks.

Water preferences

All three *Tanichthys* are ideal aquarium residents. They are undemanding with regard to water chemistry, prospering over a pH range of 6.0–8.0 and hardness values up to 14°dH. Like most stream fishes, they do not appreciate dissolved waste buildup and do best under a regime of regular partial water changes. The three species do differ with regard to their preferred water temperature. Native to southern China and the extreme north of Vietnam (Kottelat, 2001), the White Cloud is not a true tropical fish. In nature, it experiences a temperature range of 41–77°F (5–25°C). In captivity, it can tolerate brief exposures to water temperatures at the upper end of its range. However, prolonged exposure to temperatures above 81°F (27°C) are usually fatal—recall the fate of the first shipment of White Clouds sent from Hong Kong to England. Individuals kept in tanks where temperatures never fall below 75°F (24°C) are much more susceptible to velvet disease and rarely live more than a year. Fish kept in unheated tanks are much less prone to parasitic diseases and can live for up to three years, a very respectable span for a fish that rarely attains 1 inch (c. 25.0 mm) in total length.

On the other hand, the type locality of both the Sparkling Gem and the Topaz Minnow, which I suggest as a common name for *T. thacbaensis*, do lie squarely in the tropics. While both *T. micagemmae* and *T. thacbaensis* can handle temperatures as low as 59°F (15°C) without difficulty, tank temperatures between 75 and 81°F (24–27°C) appear to affect neither their ability to resist disease nor their longevity.

As might be expected in view of their temperature preferences, *Tanichthys* species make very satisfactory summer pond residents in most of North America. I have no experience in this regard, but several members of my local aquarium club, the North Jersey Aquarium Society, make a practice of giving their fishes a summer vacation outdoors. They have found that in U.S. Department of Agriculture Zone 6, it is best to wait until the beginning of June before moving *Tanichthys* outside. Water temperatures tend to fluctuate rather abruptly earlier in the year, and this can prove stressful for fish that have spent the winter in a relatively stable thermal environment.

Figure 8. The overall yellow coloration of this male *Tanichthys thacbaensis* is the basis for the species' suggested common name, the Topaz Minnow.

Figure 9. Female Topaz Minnows are less intensely colored than their consorts and have shorter fins.

That said, one need not be too hasty about bringing White Clouds back inside for the winter. North Jersey member Ted Colletti, a noted livebearer breeder who is also an active water gardener, routinely waits until early November before retrieving White Clouds from his ponds. The fish apparently can cope quite well with slow temperature drops. Given their provenance, it would probably be prudent to bring *T. micagemmae* and *T. thacbaensis* back indoors no later than the end of September. Due to their essentially subtropical character, I strongly suspect that White Clouds could be expected to overwinter successfully in USDA Zones 7 and 8; elevated summer temperatures would likely be the limiting factor in the ability of the Sparkling Gem and Topaz Minnow to thrive in these zones. (In small water gardens receiving direct sunlight, shading from overhanging and floating plants may be needed to keep water temperatures within safe limits.)

Figure 11. A male Golden White Cloud. The golden coloration is most intense in pond-raised specimens and tends to fade under aquarium conditions.

Figure 12. Female Golden White Clouds lack the broad white dorsal and anal fin edging of males and are more full-bodied. The sexes are otherwise very similar in appearance.

Feeding and keeping

These are easily fed little fish. They will eagerly consume any foods—live, frozen, or prepared—small enough to fit in their mouths. *Daphnia*, *Artemia* nauplii, and Grindal worms represent ideal live food choices, but these fish also relish frozen CYCLOP-EEZE® and Ocean Nutrition's Prepared Baby Brine Shrimp©. I have found that frozen bloodworms and glassworms are also appreciated, although it is necessary to chop these rather large food items into smaller pieces before feeding them. These are intensely social little fish and will not prosper unless maintained in a group of at least six individuals. Like most small fishes, *Tanichthys* feel most at home and look their best in a planted tank. While they certainly make a lovely addition to a Leiden- or Amano-style planted aquarium, all three species are equally comfortable if their tank's aquascaping consists of no more than a generous clump of Java Moss and a layer of floating plants.

By preference, *Tanichthys* occupy the upper half of their aquarium's water column. Both this fact and their small adult size must be given consideration when selecting their tankmates. It should be self-evident that these fish should only be kept with companions of the same general size. However, it is equally important to avoid extremely active companions who also prefer to swim in the upper reaches of an aquarium. Danios—even relatively small species such as *Danio choprae* or *D. nigrofasciatus*—do not make good tankmates for species in the White Cloud group. They will out-compete the *Tanichthys* at feeding time and tend to inhibit the normal social interactions that make the White Cloud and its relatives such appealing aquarium residents.

Companions more than half again their total length, even if they habitually frequent the lower half of the water column, also tend to inhibit the expression of the full range of the White Clouds' social behavior and push them toward the uppermost reaches of the water column. Small rasboras of the genera *Boraras* and *Trigonostigma* make excellent tankmates for *Tanichthys*, as do *Microdevario* species (Figure 13). I have found that the smaller Asian barbs, such as *Puntius gelius*, *P. phutunio*, and *P. titteya*, also make suitable companions. The same is true of dwarf loaches of the genera *Yunnanilus* and *Yasuhikotakia* (Figure 14). While I have never tried the combination, I suspect that dwarf African barbs, such as *Barboides gracilis*, "*Barbus*" *jae*, "*B.*"

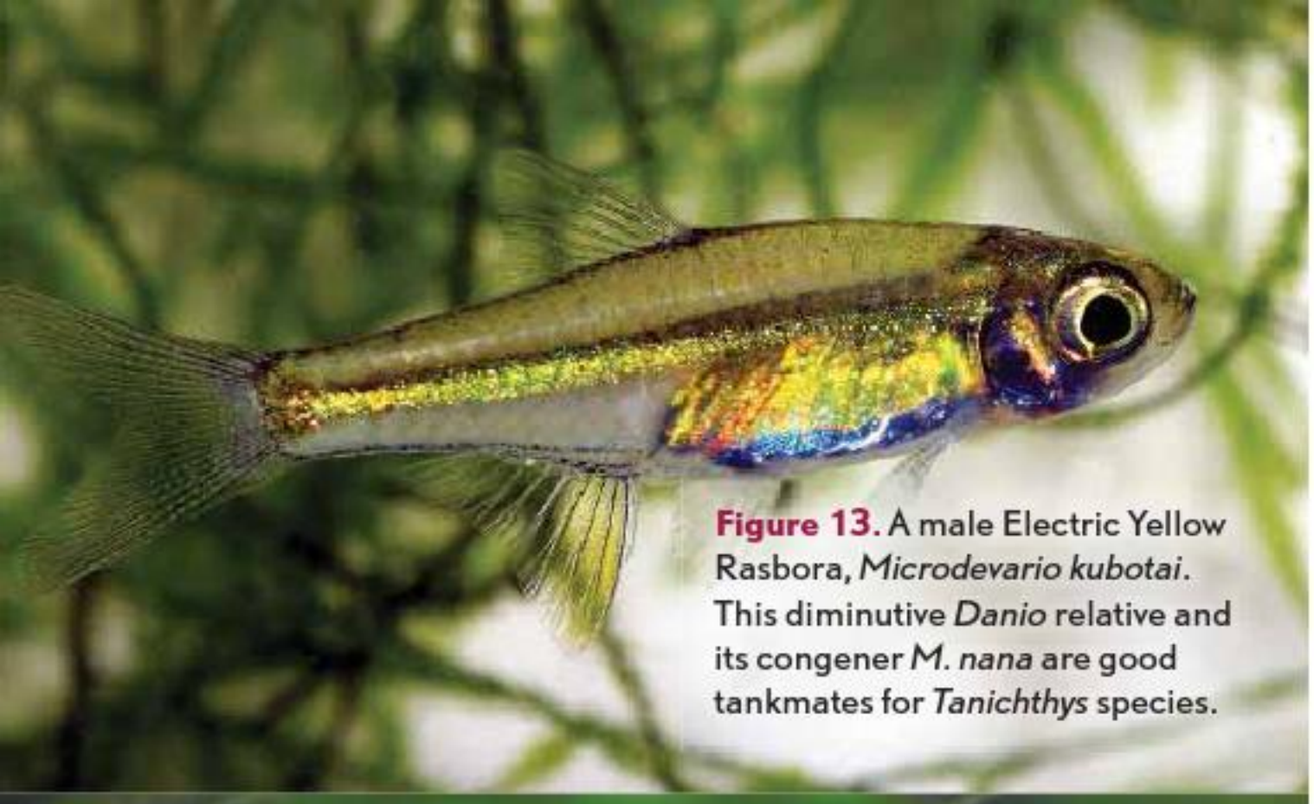

Figure 13. A male Electric Yellow Rasbora, *Microdevario kubotai*. This diminutive *Danio* relative and its congener *M. nana* are good tankmates for *Tanichthys* species.

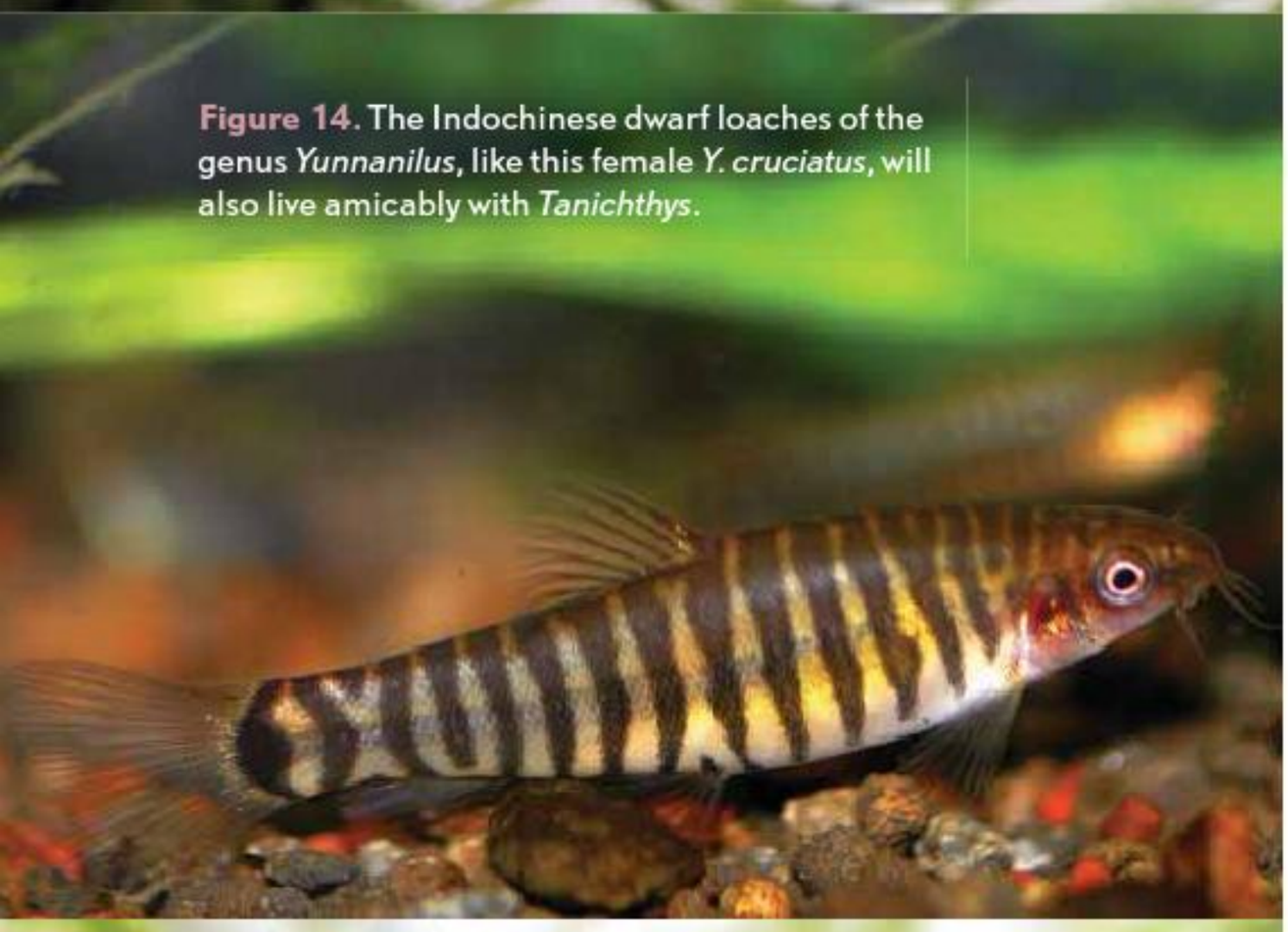

Figure 14. The Indochinese dwarf loaches of the genus *Yunnanilus*, like this female *Y. cruciatus*, will also live amicably with *Tanichthys*.

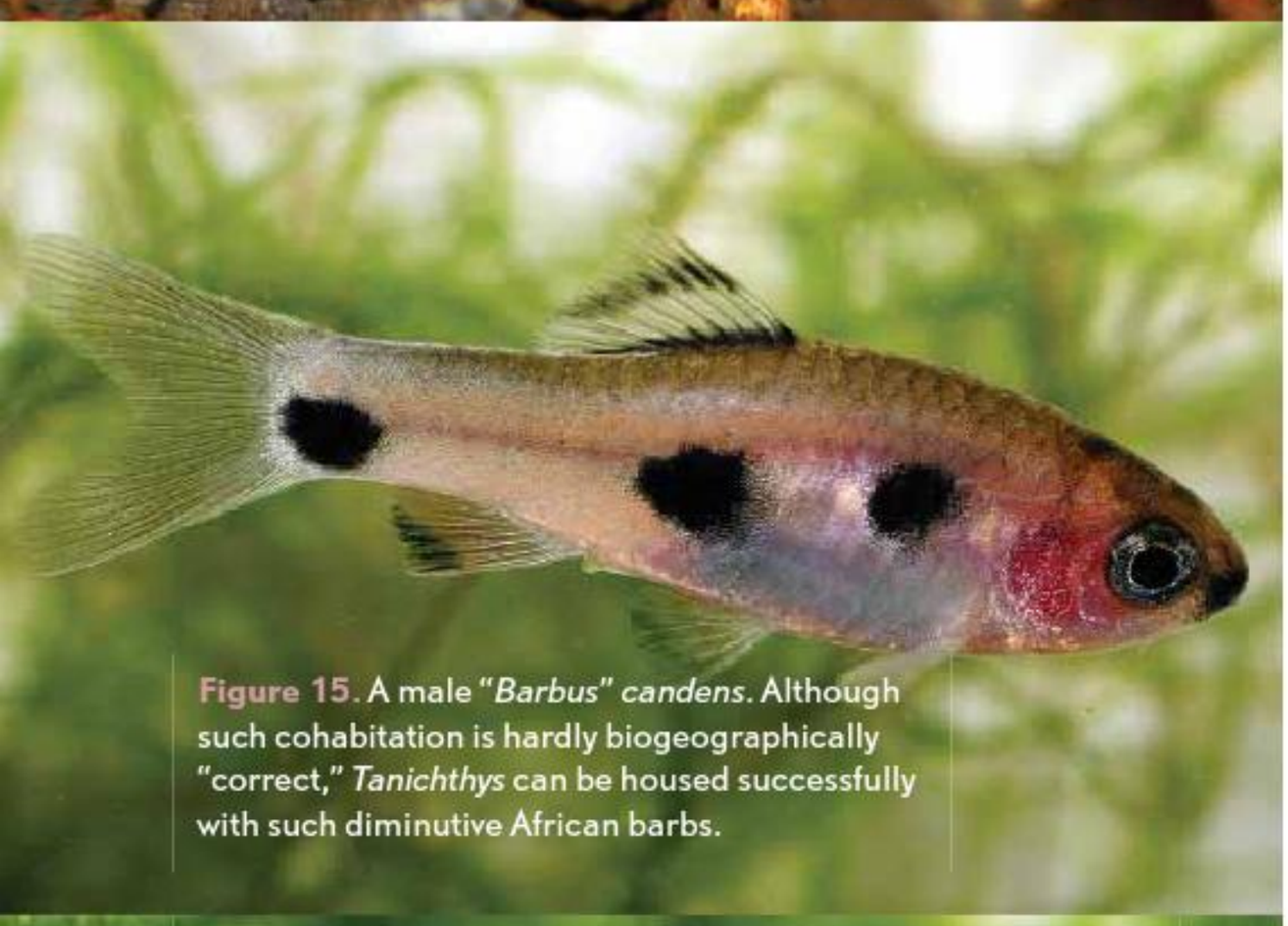

Figure 15. A male "*Barbus*" *candens*. Although such cohabitation is hardly biogeographically "correct," *Tanichthys* can be housed successfully with such diminutive African barbs.

Figure 16. *Parasphaerichthys ocellatus*, the Burmese Chocolate Gourami, is one of the smallest known representatives of the family Osphronemidae. Its diminutive size and preference for cooler water make it a good tankmate for *Tanichthys albonubes*.

candens, and "*B.*" *hulstaerti*, could also be expected to coexist amicably with *Tanichthys* (Figure 15).

In my experience, tetras do not constitute appropriate tankmates for *Tanichthys*. I found that when housed with White Clouds, even miniature species such as the Ember Tetra, *Hyphessobrycon amandae*, and the Flame Tetra, *H. flammeus*, are a bit too inclined to nip their companions' fins. *Tanichthys* do not seem inhibited by the presence of small labyrinth fishes, such as the Honey Gourami, *Colisa chuna*, or the Sparkling Gourami, *Trichopsis pumilis*. As it also prefers cool water, the Burmese Chocolate Gourami, *Parasphaerichthys ocellatus* (Figure 16), is an appropriate tankmate for *T. albonubes*. I was also pleasantly surprised by the indifference of a group of *T. thacbaensis* to a pair of *Microgeophagus ramirezi*. On the strength of that experience, I am experimenting with a group of Meteor Minnows as dither fish for the diminutive *Apistogrammoides pucallpaensis*. Since the jury is still out on how well this arrangement will work in the long run, I would still be very hesitant about using any *Tanichthys* species as dither for dwarf cichlids with a more robust build and larger mouths!

Spawning and rearing

There is a great deal to be said for housing *Tanichthys* in a single-species tank. They are certainly sufficiently active and sport bright enough colors to successfully carry off such a starring role. A group of six to eight individuals makes for an eye-catching display in a 3- to 5-gallon (11–19 L) mini-cube aquarium. When not inhibited by the presence of other fish species, male *Tanichthys* interact constantly, and their highly ritualized displays are a delight to behold (Figure 17). Such activity is most intense early in the day, which—not coincidentally—is also when spawning activity is at its peak. *Tanichthys*, like many other diminutive fish species, are continuous spawners, and females ripen a small number of eggs every few days. With the coming of first light, males actively vie for the attention of receptive females. Unlike many other cyprinids, adult *Tanichthys* are not avid egg-eaters, and when well fed will ignore their own free-swimming fry. A planted aquarium affords adults plenty of spawning sites as well as an environment that encourages the development of a community of microscopic organisms on which newly hatched fry can forage until they grow large enough to take *Artemia* nauplii and finely powdered prepared foods. Assuming that both sexes are present, the appearance of fry is inevitable when *Tanichthys* are housed in this manner. Innes was right on the mark when he predicted that the White Cloud was destined to become "the Guppy of egglayers."

It must be noted that this casual approach to breeding *Tanichthys* has its limitations. While adults

Figure 17. Aggressive displays between male *Tanichthys*—in this case *T. micagemmae*—are highly ritualized and do not result in any injuries more serious than the occasional split fin.

are not given to snacking on their progeny, the same is not true of juveniles. In my experience, recruitment continues until the first fry reach a length of .5 inch (1.2 mm) total length, at which point the populations of smaller fry abruptly disappear. Newly mobile fry do not begin to reappear until the first batch of fry begin breeding themselves, at just under an inch (c. 2.0 cm) total length.

The size of the initial cohort produced by a breeding group is also strongly influenced by their tank's furnishings. A 5-gallon (19-L) tank containing a large clump of Java Moss, a layer of floating plants, and, most important, an active sponge filter will provide plenty of foraging opportunities for newly mobile fry and thus maximize survivorship. Once the first fry have been observed, the adults should be shifted to a new breeding setup if the aim is to maximize fry production. At this point, regular offerings of appropriately sized live and prepared foods will assure rapid growth. Paradoxically, the metallic green mid-lateral stripe that earned *T. albonubes* the designation of "poor man's Neon Tetra," and also features prominently in the color pattern of *T. micagemmae*, is most intense in fish between 0.5 and 0.75 inch (1.0–2.0 mm) total length. A tankful of *Tanichthys* fry in this size range is truly a sight to behold.

At the brink of extinction

Given its status as a staple of the aquarium hobby, it will probably come as a surprise to readers of this article that *T. albonubes* is classified as critically endangered (Yue and Chen, 1998). As alarming as this seems, it represents a dramatic improvement in the White Cloud's conservation status—in the 1980s it was believed to be extinct in nature (Liang et al., 2008). In addition to the Vietnamese population already alluded to, relict populations have been recently discovered in Guangdong province on the Chinese mainland (Yi et al., 2004) and on the island of Hainan (Chan and Chen, 2009). Habitat degradation caused by deforestation and the erosion that invariably follows the loss of forest cover from steep slopes appears to be the primary reason for the disappearance of this diminutive minnow from most of its formerly extensive range. Detailed information on the conservation status of *T. micagemmae* and *T. thacbaensis* is lacking, but given the apparently very limited known ranges of both species, they would be classified as endangered following the criteria established by the International Union for the Conservation of Nature.

As all of the known wild *Tanichthys* populations lie outside of protected areas in landscapes that continue to be profoundly modified by human activity, it is difficult to be optimistic about their near-term survival prospects. While their extirpation would be tragic, the existence of a captive population of *T. albonubes* whose size certainly exceeds by several orders of magnitude that of this species' total free-living population guarantees that extinction in the wild will not be synonymous with global extinction for the White Cloud.

Indeed, the White Cloud's circumstances illustrate dramatically the role that the ornamental fish hobby can play in assuring the survival of *T. micagemmae*, *T. thacbaensis*, and the many other small tropical freshwater species that rarely attract the attention of either governmental or non-governmental conservation agencies. The large-scale commercial production of such species constitutes, in effect, a self-financing captive breeding program that assures the survival of species at risk until such time as their circumstances in the wild improve, or, in the most extreme case, allow their reintroduction. I therefore strongly urge readers to make every effort to welcome

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the Sparkling Gem and Topaz Minnows to the ranks of ornamental fishes with the same enthusiasm that their forebears in the hobby embraced the White Cloud.

Acknowledgments

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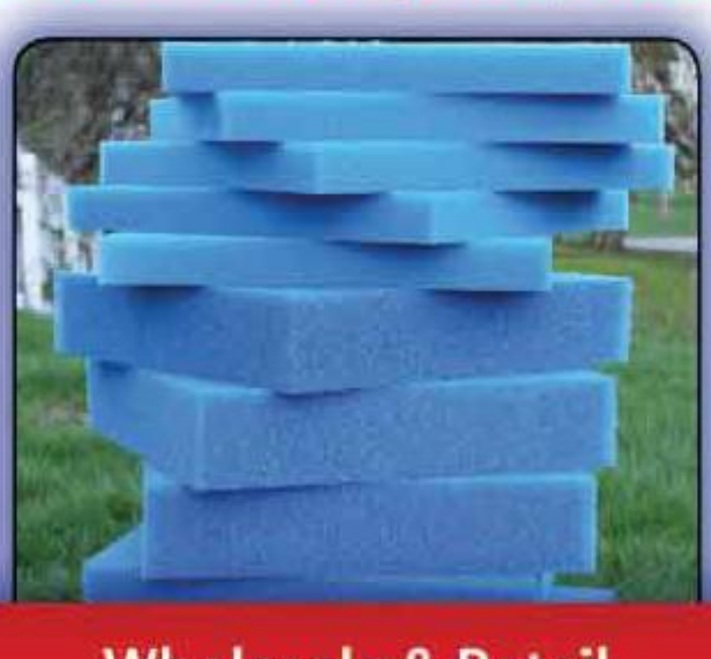

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Neolamprologus sexfasciatus "Blue"

by Wilhelm Klaas • *Neolamprologus sexfasciatus* has never achieved great popularity among cichlid keepers. Even so, the species is quite well known in the hobby and much appreciated by some, but it is often confused with *Neolamprologus tretocephalus*. The blue *Neolamprologus sexfasciatus* is even more sparsely represented in the literature. Therefore, I believe the so-called Six-Bar Lamp" deserves a little push into the aquaristic spotlight.

Neolamprologus sexfasciatus, popularly known as the Six-Barred Lamprologus or Six-Bar Lamp.

The distribution of *Neolamprologus sexfasciatus* covers the entire southern end of Lake Tanganyika. The west coast near Cape Tembwe and the east coast near Isonga, north of Ikola, have been described as the northernmost points of its distribution. The so-called *N. sexfasciatus* "Blue" is encountered between Moliro, Congo, and Tanzania, and along the coast of Zambia. The animals live mainly in shallow waters along the shores.

When I first saw *N. sexfasciatus* in an importer's tank I was not thrilled, because the pattern described in the literature was absent. The dominant color was yellowish white with dark blue bands. An inquiry revealed that these particular animals were not the blue but the yellow form of *N. sexfasciatus*. This form is supposed to be less aggressive and should reproduce easily in the aquarium. Further reading revealed that this variant might come from Cape Tembwe. However, there should also be a deep yellow variant from Kekese, which I have not encountered so far.

As the name suggests, *N. sexfasciatus* has six dark blue to black bands on a pale blue background; the seventh band, located above the eye, is not counted. The species is easily confused with *N. tretocephalus*, which has fewer bands by one and is found in the same places as *N.*

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sexfasciatus. Eventually, *N. tretocephalus* ruled Lake Tanganyika aquariums and *N. sexfasciatus* faded further and further into oblivion. All this could not deter me from searching for the desired blue *N. sexfasciatus*.

My pair of *Neolamprologus sexfasciatus* "Blue" moved into an aquarium measuring 72 x 24 x 24 inches (180 x 60 x 60 cm). The tank was decorated with holey rock and a flowerpot. Since I knew about the aggressiveness of these animals, the tankmates I chose were robust Lake Tanganyika cichlids: *Lepidiolamprologus profundicola* and *L. elongatus*.

The days dragged on, but no offspring turned up. Maybe I had missed something in the arrangement of the tank? From an aquarist friend I learned that his animals had spawned in a tube, so I installed one in my tank. The female immediately inspected and accepted it. Now, it had to work! But month after month passed, until my patience was at an end and my interest had significantly decreased.

Due to this lack of attention, I didn't notice that the male had suddenly become more aggressive. Nor did I notice that the female had started hiding behind the heater—and then one day, I found her floating belly-up in the tank. Another attempt with a new female led to the same result. One reason for the absence of breeding in captivity may be the extremely pronounced pair bonding in *N. sexfasciatus*; most pairs end up getting separated during collection.

Neolamprologus sexfasciatus can reach an overall length of up to 6.3 inches (16 cm) in the wild. In the aquarium, most animals known to me reached a size of a little more than 4 inches (10 cm). According to the literature, nearly 1,000 eggs are produced, and the biparental care practiced by this species has thrilled many divers in Lake Tanganyika. Their natural diet of insect larvae and crustaceans can easily be mimicked, because frozen bloodworms and small crustaceans are available in stores everywhere. They will even accept dry food.

To maintain *N. sexfasciatus* under appropriate conditions, the tank size mentioned above should be viewed as a standard, while a length of 60 inches (150 cm) should be considered the minimum. There are no extraordinary requirements for water quality, but strong filtration and weekly water changes are compulsory.

If you want to maintain a not-so-common Lake Tanganyika cichlid in the aquarium, the blue *Neolamprologus sexfasciatus* is surely worth considering. Should you be lucky enough to obtain a harmonizing pair, it should be possible to distribute this blue beauty as offspring. Let's give it a try!

Group of adolescent *Neolamprologus sexfasciatus* "Blue."

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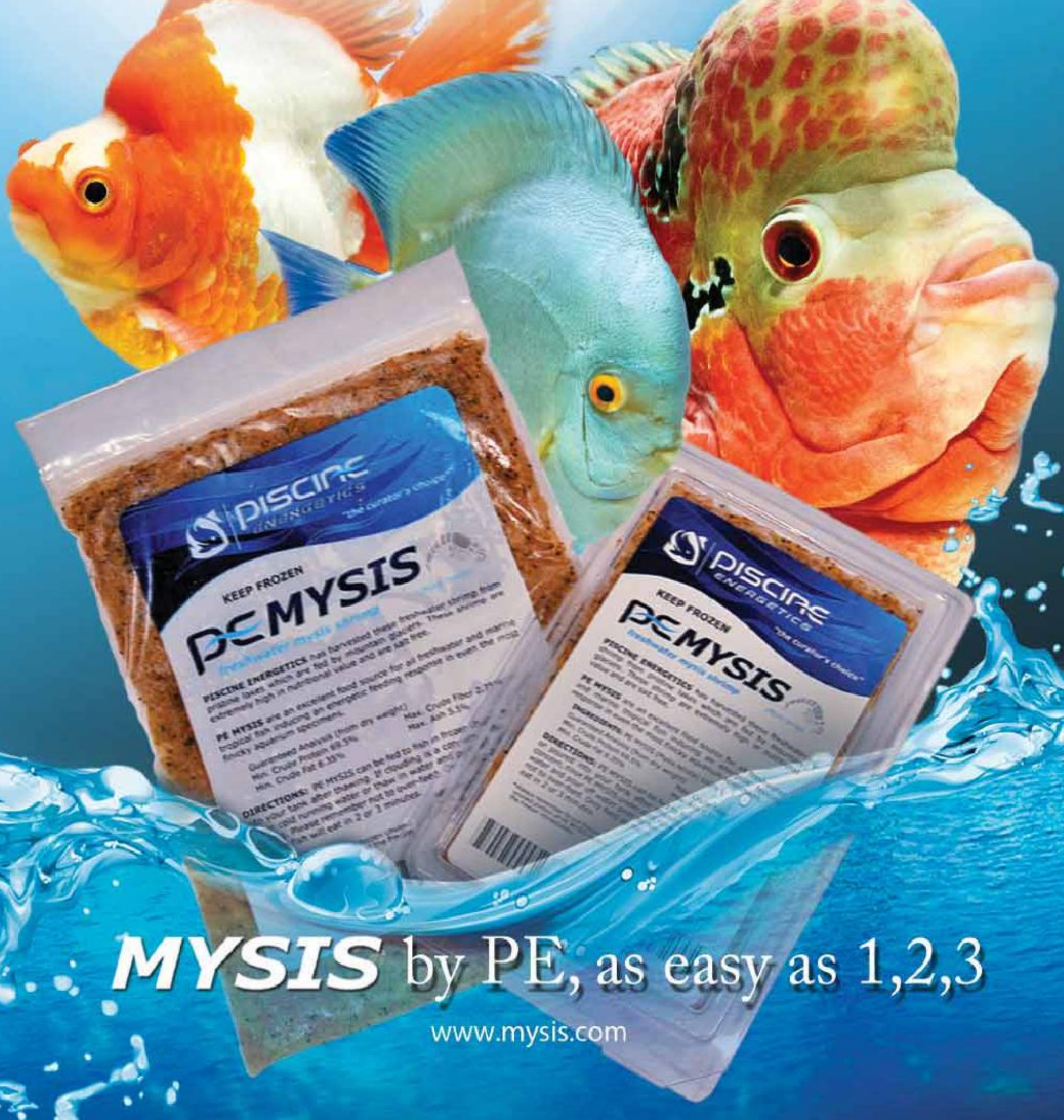

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Nick Xyong's planted riparium

RIVER

AQUATIC PLANTS

article by Devin Biggs; images by Nick Xyong • Among planted aquarium enthusiasts, some stand out for their long-term dedication to aquatic gardening, their attention to detail, and their natural artistic sense. Among those who quickly come to mind is Nick Xyong of northern California, who has developed a series of aquascapes in his ADA 120-P tank, each one building upon the mastery of experience accumulated through previous plantings.

Underwater view of 65-gallon (165-L) aquarium with hybrid Altum Angels, hardscape, and plants. Opposite: author Nick Xyong.

WILD

THE SYSTEM

Enclosure: ADA 120-P (Aqua Design Amano): 65-gallon (165-L) rimless, high-clarity glass aquarium (48" X 18" X 18" [120 cm X 90 cm X 90 cm])

Lighting Fixtures: Four 48-inch (54-watt) Tek Light (Sunlight Supply) Lamps – 54-watt Powerchrome Midday T5 Fluorescent (Giesemann Lichttechnik und Aquaristik GmbH)

Water Filtration: CFS 500 (Odyssea), 500-gallon (1,890-L) canister filter

CO_2 Injection: 20-pound compressed cylinder, Victor Dual-Stage regulator (Victor Technologies), solenoid valve, and timer

A rich combination of plants decorates the above-water and underwater portions of the aquarium.

Curious about the techniques, equipment, and theory that Nick used for his latest scape—an array incorporating a richly planted underwater area, vibrant riparium planting, and arresting livestock display—I asked him to describe his approach so I could gain some insight into planning aquascapes and planted aquariums.

Substrate and hardscape

The chocolate-colored Aqua Soil Amazonia (Aqua Design Amano) substrate serves as a nutritive and visual foundation for the aquarium mini-ecosystem and display. Nick is using the hard-to-find Seiryu stone on loan from a friend. This dark-colored rock is sourced from mountains in Japan and is apparently a micritic (mud-based) limestone. The characteristic gouged facets and grooves of Seiryu stone, a texture that makes the material seem much larger in size, form as the calcium carbonate limestone matrix dissolves in the presence of water more quickly than the veins of more resistant minerals.

Manzanita wood has become one of the most popular hardscape materials since aquascapers discovered its useful properties some time ago. Manzanita plants are among several species of *Arctostaphylos*, a genus of shrubs and small trees belonging to Ericaceae, the heather family, that inhabit chaparral brushlands in western North America. Manzanita wood is rot-resistant—you can keep pieces of it underwater for years—and grows in gnarled, sculptural shapes used to great effect as expressive elements in planted aquascapes.

Underwater planting

Nick says that he does not closely monitor nutrient levels and water parameters, but instead employs "estimative index" (EI) fertilization, a strategy that combines ample fertilizer

dosing with large weekly water changes to maintain water chemistry and nutrient levels within favorable ranges. In classic EI fertilization, as introduced by Tom Barr in 2005, generous amounts of plant nutrients are added daily or throughout the week, keeping an eye on the response of the aquarium's inhabitants and doing a 50 percent water change each weekend.

Nick, who lives in the San Francisco Bay area, further explains that he has good results using 100 percent municipal tap water with a high dissolved-mineral content. Such water exerts a strong buffering effect and maintains carbonate hardness and pH at high levels, but Nick's plants have acclimated to these conditions and grow very well. Water temperature is maintained in the 72–75°F (22–24°C) range.

Phoenix Moss (*Fissidens fontanus*) adorns some upper surfaces of the manzanita branches. Nick says this moss is desirable because it grows as tidy, slowly creeping mats with rhizoids that hold tight to the driftwood surfaces. By contrast, Java Moss (*Taxiphyllum barbieri*) and certain

This shot offers a good view of the riparium foliage, with the flowering *Ruellia brittoniana* "Katie" in the foreground and the taller *R. brittoniana* species and other plants at the back.

Riparium plant varieties/species from left to right: *Oplismenus hirtellus*, *Cyperus involucratus* "Baby Tut," *Ruellia brittoniana* "Katie," *R. brittoniana* (species plant), *Pilea cadierei*, *Chamaedorea cataractarum*, *Acrostichum danaeifolium*, *Pandanus pygmaeus*.

Aluminum Plant (*Pilea cadierei*) is one of the best plant choices for growing on riparium trellis rafts.

other, more common aquarium mosses spread more quickly as tangles of foliage and can be difficult to manage.

An aquatic fern, *Marsilea quadrifolia*, covers the underwater foreground. This plant and other *Marsilea* species are good examples of aquatic plants with strong leaf dimorphism, expressed when they grow in either underwater or emersed (above-water) conditions. The emersed foliage of *Marsilea* is a square, four-lobed leaf, lending it the common name "Water Clover," while its underwater foliage is a smaller, spoon-shaped single lobe. *Marsilea* ferns are excellent carpeting plants that are generally less demanding than other small aquatic plants used for this purpose, such as *Glossostigma elatinoides*.

Among other plants included as accents in the underwater layout are *Anubias barteri* var. *nana* "Petite," *Bolbitis heteroclita*, *Cryptocoryne nurii* "Pahang mutated," *C. wendtii* "Green Gecko," *C.* x *willisii* (lucens), *Cyperus helferi*, and *Staurogyne repens*.

Riparium planting

The riparium planting includes taller background plants rooted in Riparium Hanging Planters (Riparium Supply) containing baked clay gravel, as well as shorter mid-ground plants planted on Riparium Trellis Rafts. (For the uninitiated, a riparium recreates the wet habitats found along the edges of lakes, rivers, ponds, and streams. This zone hosts marginal plants, which are rooted in the saturated soil at the edge of the water but hold their leaves up in the air.) Among the many kinds of semi-aquatic plants suitable for growing in a riparium, a rather limited number function well as trellis raft foliage. The trellis raft plants grow with their stem bases and roots suspended directly in the aquarium water, so they are by necessity less demanding of nutrients.

Two different varieties of Mexican Petunia (*Ruellia brittoniana*) comprise much of the riparium foliage. The dwarf horticultural selection, *R. brittoniana* "Katie," has bright blue flowers and short leaf internodes and grows to only about 8 inches (20 cm) tall. With bright to moderate light and good root fertilization, this plant flowers readily, and it has been almost ever-blooming in Nick's system. The taller species of *R. brittoniana* is another easy bloomer, but it grows fast and its stems can reach 36 inches (90 cm) in height. It would be an otherwise awkward plant in a riparium setup, but it responds well to pruning and is easily maintained with a shorter stature.

Less conspicuous in the riparium planting is the grass-like foliage of a single *Pandanus pygmaeus* plant. This member of the Pandanaceae family is sometimes planted as terrestrial landscaping foliage in Southeast Asia and other tropical areas, but rarely appears for sale in the United States. True to its name, *P. pygmaeus* reaches only about 12 inches (30 cm) in height, while most other *Pandanus* species grow to the size of large bushes or small trees. I found scant published information on *P. pygmaeus*, but it is apparently native to Madagascar. *Pandanus* plants are known by the common name "Screw Pine" because of their spiny leaf margins and foliage that unfurls from the top of the plant with a characteristic spiral pattern. Nevertheless, they are not related to pines or to palms, with which they share a similar general appearance, but are

The striking foliage of *Cryptocoryne nurii* "Pahang mutated."

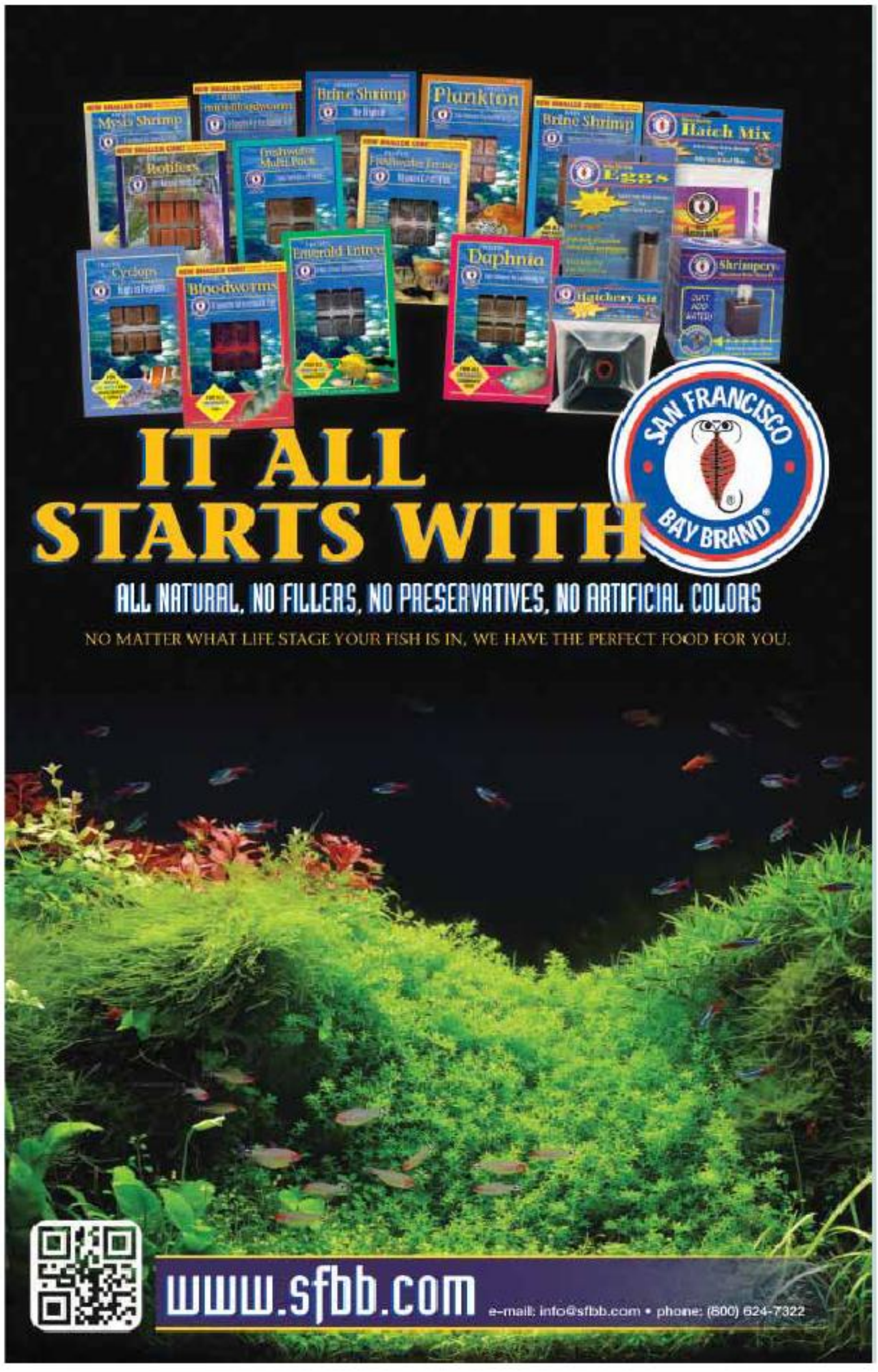
Above: Calico Long-Fin Bristlenose Pleco (*Ancistrus* cf. *cirrhosus*), *Yasuhikotakia sidthimunki*, and *Yunnanilus cruciatus* at play in a soft green field of *Marsilea quadrifolia*.

Here, hybrid Altum Angelfish pose for the camera.

instead in their own primitive monocot plant group.

Most *Pandanus* species originate from swamps or shoreline habitats in tropical areas, so they can be good riparium representatives of these kinds of environments. A recent *AMAZONAS* article about *Parasphromenus* Licorice Gouramis (Hallmann, 2012) included a picture of a blackwater fish habitat in Cherating, Malaysia, with many specimens of what looked like a shrubby *Pandanus* species growing along its banks. I am currently growing a pair of the larger *Pandanus tectorius*, a salt-tolerant, seaside species from Hawaii and other places in the Pacific region, in a 65-gallon (165-L) brackish riparium along with several mangrove tree species. As far as I know, Nick, a few other hobbyists, and I are the only aquarists who have grown *Pandanus* as riparium subjects in fish tanks, but these plants seem to adapt well to riparium conditions and deserve more attention for this kind of growing. Especially intriguing features of these unusual plants are the stilt roots that they grow around the bases of their stems. A useful general description of the Pandanaceae is provided in an article in the *Annals of the Missouri Botanical Garden*, "A Guide to Collecting Pandanaceae (*Pandanus*, *Freycinetia* and *Sararanga*)" (Stone, 1983).

The Aluminum Plant (*Pilea cardierei*) and Variegated Basket Grass (*Oplismenus hirtellus*) grow on the Riparium Trellis Rafts as mid-ground foliage. Riparium culture is similar for both of these plants: The cut stems are simply inserted through the holes in the trellis raft with at least one leaf node below the water level. New roots sprout from the leaf node and the plant is sustained with nutrients dissolved in the aquarium water. Trellis raft foliage is important for developing visual depth in the riparium layout, while these plants also add color and texture.



Livestock

The hybrid Altum Angelfish are the stars of the 120-P aquarium, but there are several other appealing fish inhabitants, including pleco catfishes (*Ancistrus dolichopterus* L183 and *Ancistrus* cf. *cirrhosus* "Calico Long-Fin Bristlenose Pleco") and loaches (*Yasuhikotakia sidthimunki* and *Yunnanilus cruciatus*). Amano shrimp (*Caridina multidentata*) add a little more action and munch away at algae growth.

Interview

Devin Biggs: *How did you first become interested in the planted aquarium hobby?*

Nick Xyong: My first fish were fancy bettas (*Betta splendens*) that I got when I was in the sixth grade. I remember the library trips I took just to check out all the books that I could find on bettas. I studied them extensively and was able to breed them successfully at that young age. My family moved a lot when I was younger so I was not able to have larger tanks. As a teenager I became interested in other hobbies and didn't touch another aquarium until I got to college. I think it was around 1997 that I had the opportunity to keep five Red-Bellied Piranhas. That sparked my interest in aquariums once again and prompted me to buy my first 20-gallon (75-L) tank. I knew nothing about lighting, ferts, or CO_2, so I was only able to keep *Elodea* and swordplants alive for

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a little while. In 2009 I got my first "big" tank. A family friend gave me a 39-gallon (148-L) aquarium. I gladly accepted it and started doing more serious research about planted aquariums. Everything that I have done since with fish tanks and aquarium photography has been logged on the Planted Tank Forums (www.PlantedTank.net/forums), a popular online community, and my own site (www.SpeedieAquatics.com).

Do you have any other aquariums in addition to the 120-P?
I have plenty more...these days most of them are filled with shrimp. My only planted tanks right now are the 120-P and a 40-gallon (150-L) breeder that I use for holding and propagating plants. I also have a couple of shallow seedling flats with humidity domes where I keep some of my favorite emersed aquatic plants.

Your photographs are so bright and clear. What kind of camera and lens are you shooting with?
Thanks! I shoot with a Canon EOS 60D. My two favorite lenses are a Canon EF-S 17–55mm f/2.8 and a Canon EF 100mm f/2.8 USM macro.

Are you active in any aquarium clubs?
I've been a member of the San Francisco Bay Area Aquatic Plant Society for a long time. We're the best aquatic plant club out there!

Please tell us about those angelfish.
These angels were bred by Niel Oyama. He's a well-known breeder in the angelfish community. They're hybrid crosses that have 75 percent Rio Negro Altum Angel blood. They are beautiful fish and behave like little pigs...always on the lookout for me to drop food in the tank.

Do the riparium plants cast much shade on the underwater area?
There's a substantial amount of shade, yes, although the underwater plants underneath don't seem bothered by it. They grow more slowly than normal, but they're healthy.

What is your favorite aquarium plant?
My all-time favorite is *Cryptocoryne nurii* "Pahang mutated." I'm growing a few of them in the 120-P. It's such a beautiful plant, with its distinct orange veins and tiger-like markings. I love this plant!

Thanks so much for sharing your pictures and detailed descriptions of this beautiful planting. I look forward to seeing your next creation!
The pleasure is mine, sir. Thank you for the opportunity.

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First reported captive spawning of *Gastromyzon lepidogaster*

by Heinrich Gewinner • A few years ago, after several decades in the aquarium hobby, I developed an interest in a group of fishes that have become collectively known as hillstream loaches. For many species, breeding has not yet been successful, and for *Gastromyzon lepidogaster* captive husbandry has not been reported at all. What is their secret?

Even though most aquarists are hardly aware of it, there are a great variety of hillstream loach genera and species. My first hillstream loaches belonged to the species *Sewellia lineolata*. I kept them in a separate 20 x 12 x 12 inch (50 x 30 x 30 cm) aquarium with an air-driven Poret Foam filter on the back wall, so the current was not very strong. These fish were active during the day, constantly darting around. At first, it was not clear to me whether they liked each other or preferred to fight.

After four weeks, the question was answered: I kept seeing juveniles. This also meant that they did not prey heavily on their young. However, this posed a new problem for me—how to remove the small fry from the tank. Finally, I solved this problem quite easily, and the approach I used has

H. GEWINNER

worked with all my hillstream loaches to this day.

The fishes in this group require regular water changes. Instead of just letting the used water run down the drain, I use a hose with an inner diameter of about 0.25 inch (6 mm) to siphon it into a plastic container that holds about 0.75 gallon (3 L) of water (an old vegetable drawer from a refrigerator works well). When siphoning water from among the stones on my first try, I collected about 25 fry in different stages of growth in the container. After the mud had settled, it was easy to extract the youngsters with the help of airline tubing and move them to a separate tank. After another three weeks, I had already collected more than 200 fry.

Before long, I obtained more hillstream loach species, and the described method for propagation worked, at least partially, with most of them. A

Above: Typical habitat of *Gastromyzon* on Borneo: hillstream loaches find food and shelter among pebbles of varying sizes.

Inset, above left: Orange morph of *Gastromyzon lepidogaster*, pictured in the wild (Kinabalu, Sabah).

Opposite page: During courtship, the smaller male positions himself in front of the female.

Right: *Gastromyzon lepidogaster* in the author's tank.

TOP: H.-G. EVERS; INSET: R. CALVETTI; BOTTOM: H. GEWINNER

Top: In the first weeks of life, the young *Gastromyzon* are very dark in color and cruise around in the parental tank.

Bottom: *Gastromyzon lepidogaster* at about 0.8 inch (2 cm) in the fry tank.

major difficulty was the fact that not all males and females could be distinguished easily.

Easy to feed

In November 2011, I received a call from a friend from Hamburg. He said, "Heinrich, a Hessian wholesaler has just received some interesting fishes; besides rainbowfishes, there is also an unknown hillstream loach. Do you want to meet me there on the 24th?" What a question! Because of their size, it was clear that these fish had to be *Gastromyzon lepidogaster*. A total of 10 animals had arrived, 7 of which moved into my basement. The remaining three, among them one with a completely different spotted pattern (instead of blotched), went to Hans-Georg Evers for photos.

My *Sewellia* had to move to one of the larger tanks that held rainbowfishes, while the newcomers got their own aquarium. From the beginning, they obviously felt very comfortable and were not at all shy, despite being wild-caught. They readily accepted any food that I offered, including frozen food, flakes, and granules. They had problems with free-swimming live food, but they are not designed to catch that type of food. However, one individual refused food from the beginning and eventually died. And once I forgot to cover the tank properly after feeding, and the largest and most beautiful hillstream loach decided to bask under the lamp. Now there were only five left.

Unlike the *Sewellia*, the *Gastromyzon* moved somewhat clumsily, probably due to their size, but they were just as active during the day. So every second or third day I performed a water change as described, but even with a magnifying glass I could not find any babies.

Success with the new arrivals

In the second half of March 2012, a call came from Evers: "The photo shoot is over, and I need the space! Do you want the two fish? There is a big one and a small spotted one." Probably because he wanted to challenge me, Hans also hinted, "So far, there has been no successful propagation in captivity."

There was quite a party in the tank when the new fish arrived. The large specimen with the blotches was unpopular with the incumbents and was constantly attacked. By the next morning, the fish was dead. Quite the contrary with the small spotted fish: it was immediately accepted and constantly sat on a beautiful round pebble with one of the other fish. "Sat" is actually the wrong term; it was more of a continual jumping around. I started to get my hopes up.

After two weeks, my optimism proved to have been well founded: I siphoned off some 30 young animals. Some already had a very slight pigmentation; others were still tiny. The fry were many times smaller than young *Ancistrus*. If I wanted to find them in the mud, I could really only see them when they moved. By mid-April, I had collected 600 babies, which had reached a size of about an inch (2–3 cm) and were now housed in a tank covered with *Anubias*.

H. GEWINNER; OPPOSITE PAGE: H.-G. EVERS

Up to a size of about 0.4 inch (1 cm), the fry are darkly pigmented.

As the fry grow, the base of the tail turns black and the brown ground color is overlaid with black spots that later merge to form vertical stripes.

This juvenile, approximately 0.8 inch (2 cm) long, shows the banding typical at this age. They start to develop the adult pattern when they are about 1.4 inches (3 cm) long.

Spotted or blotched?

Let's briefly go back to the spotted fish. Among my offspring there were initially also two fish with spots on their backs. Gradually, however, the blotching spread upward from the ventral side, and now they are no different from the remaining animals.

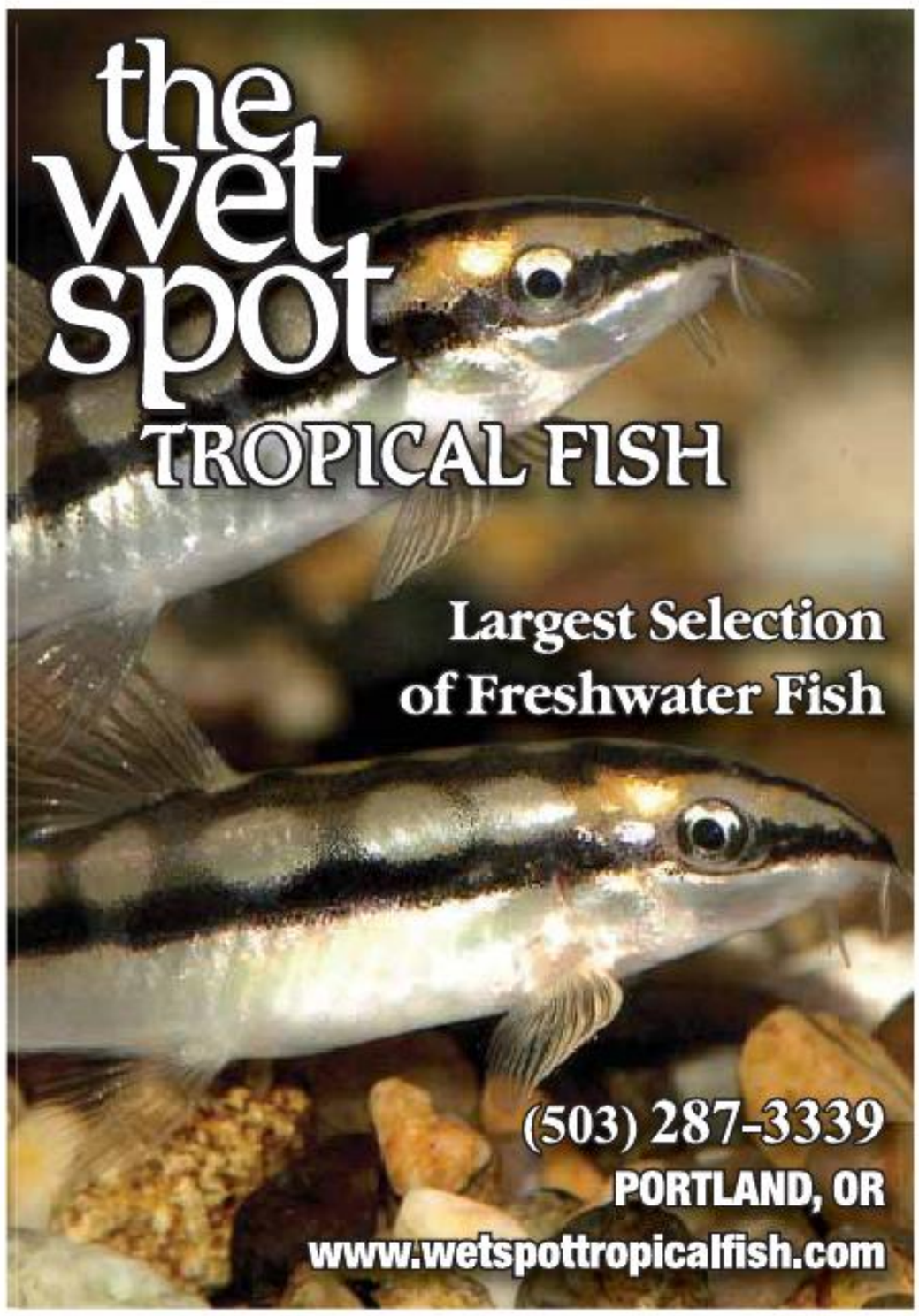
I am surprised that all of the juveniles at a size of approximately 1.2 inches (3 cm) are vertically striped and have no spots. I wonder if that pattern is going to change. If not, that would probably indicate that there is a similarly sized second morph (or species?) that is spotted. I have received pictures of *Gastromyzon lepidogaster* in the wild, taken by Renato Calvetti close to Mount Kinabalu in Sabah. The species is known for its variability, but the magnificent orange-colored type seen on page 75 was not known before this.

In summary, even *Gastromyzon lepidogaster* can be easily propagated under the appropriate conditions. Of course, you must have the good fortune to acquire fishes of both sexes that get along and feed them a suitable diet.

Many of the frequently reported "prerequisites," such as strong current and almost sterile water, have proven to be unnecessary. Both *Gastromyzon* and *Sewellia* almost always stay in the calmer areas of the aquarium.

These fish are not shy at all and come out during the day.

H. GEWINNER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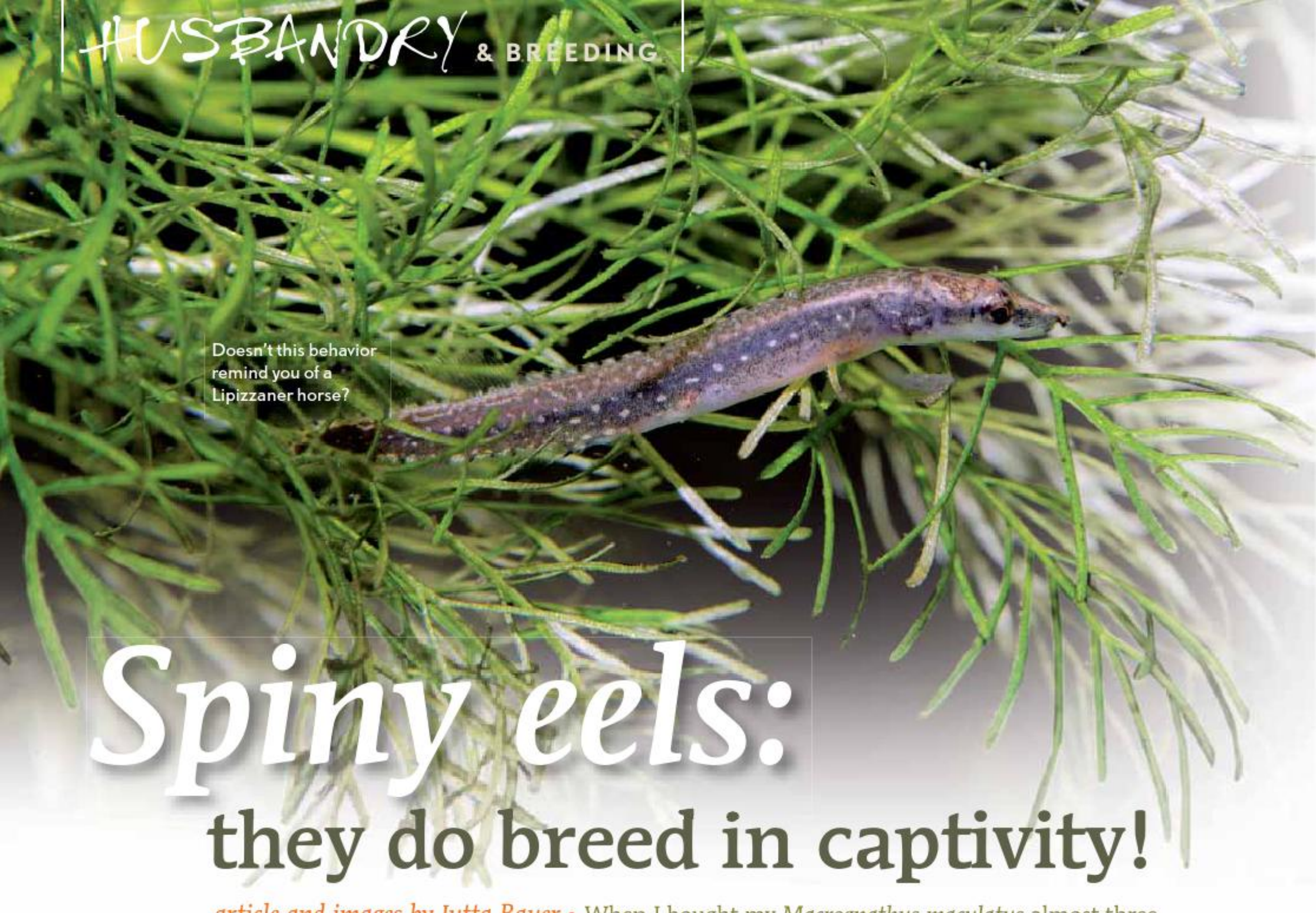


Doesn't this behavior remind you of a Lipizzaner horse?

Spiny eels: they do breed in captivity!

article and images by Jutta Bauer • When I bought my *Macrognathus maculatus* almost three years ago (they were sold to me as *M. circumcinctus*), I had no idea that one day I would breed them. It is amazing how little information is available about this group of fishes, since they have been established in the hobby for so long. The notion that they would not breed in captivity, at least without hormones, was well known to me. But soon I was to be taught a lesson!

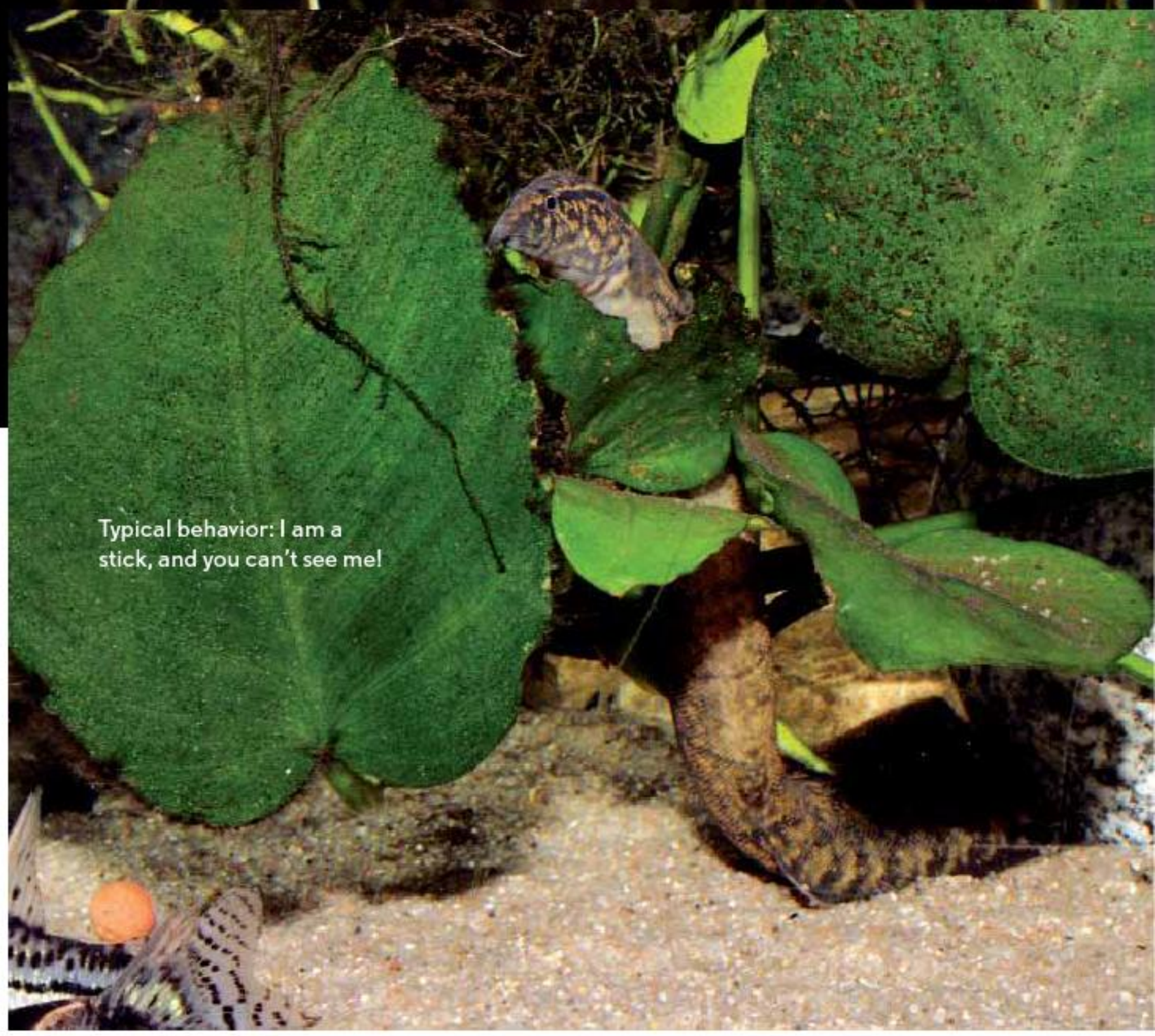
I acquired my Frecklefin Spiny Eels in a group of three because of my deeply held view that no animal should be kept completely without company, unless they tear each other apart. I did not know at the time that I had bought two females and one male. At first, there was great friction between the larger female and the much smaller male. The female chased him continually, and eventually I separated them for six months until the male had grown to equal size. From that moment on, the secret love affair between the two began.

Surprise

Sometime in June of 2010, I was doing my usual morning inspection rounds. As I sat in front of the eel tank, suddenly I saw a 0.2-inch (5-mm) wormlike something swimming through the current, and my first thought was "Oh, no! Planaria!" The creature stopped and hung onto the side of the tank, where I could get a better look. First doubts: a planarian flatworm with a dorsal line? I had never seen such a pattern before. I got myself a magnifying glass and looked at the thing very closely. It dawned on me very slowly that this might be an eel. No, it could not be true! But the more I inspected it, the more certain I became: it could only be a spiny eel larva.

I removed the tiny creature from the tank and moved it into a hurriedly furnished breeding tank. Meanwhile, five more larvae appeared in the aquarium, so I moved them, too. Now I could observe them more closely and take the first photos. Honestly, I have been stunned at how cute the juveniles of other fish species are, but these babies, with their round faces, huge eyes, and always-erect pectoral fins, were enough to make anyone swoon.

A 0.19-inch (5-mm) eel larva tries to swallow a glass worm (fly larva). After 15 minutes, the little guy gave up.



Typical behavior: I am a stick, and you can't see me!

To date, I have not witnessed a single spawning or found a clutch of eggs. Trying to film the spawning with a continuously running video camera failed, because the fish discreetly withdrew from the field of view. I know from reports of a breeder of *Macrognathus pancalus* that spawning always takes place in the early morning hours, preferably in feathery floating plants. Because my tank lacked floating plants, I suspect that the roots of the large *Anubias* served as spawning grounds. After I found the first larvae, every Thursday morning another 6 to 15 babies appeared promptly. As far as I could tell, the larvae hatched with yolk sacs and spent three to seven days lying on the bottom until the yolk sac was used up. Then they started to swim free.

The juveniles paddled around the aquarium in search of food. They did not hide and were not very cautious. However, it was striking how slowly they moved. They seemed to act like pieces of wood, drifting through the water without proper propulsion. This probably saved them from being viewed as food by the *Synodontis lucipinnis* and *Dianema urostriatum* in the tank. Unfortunately, my orphaned *Labidochromis caeruleus* "Yellow," who was watching closely what I was chasing with my net, got the idea that this "driftwood" might be something edible—so he had to be moved.

The surroundings are always closely watched, even the outside of the aquarium.

Above: The author's spiny eel kindergarten.

Problems with glass bottoms

Initially, rearing the eels posed no major difficulties. The babies ate anything that fit into their mouths, but only after extensive investigation: *Artemia*, *Cyclops*, Grindal worms, even retracted *Hydra*. A spiny eel baby encountering a new prey item is a spectacle without equal. The animal is suspiciously viewed from all angles, tentatively sniffed, and then finally snapped up.

The first feedings with glass worms (larvae of the *Chaoborus plumicornis* fly) triggered gales of laughter because the sniffing of the larvae, of course, induced the typical spasmodic flight of the glass worm. The confusion among the spiny eel babies was great, and it took some time until they finally captured the first prey.

The fry grew with an uncanny speed. Within a week they doubled their length; after two weeks, they were already

The very first spiny eel baby, which was mistaken for a planarian and almost destroyed.

Below: As you can see, the babies were even allowed to "dance" on daddy's nose.

0.6–0.8 inch (15–20 mm) long. Within four months they were 2.5–3 inches (6–8 cm) in length. At the beginning they lacked the typical rostrum. In the case of *Macrognathus maculatus* this starts to grow at the age of about six weeks, when the animals are starting to lose their immature appearance.

I now had about 70 juveniles, but when I relocated them to a tank without substrate I encountered problems. The symptoms were always the same: a necrosis started around the anus, then continued toward the tail. Within days, the affected animals died. This necrosis did not appear to be contagious. It turned out to be a bacterial infection that was apparently due to contact with the bare glass tank bottom. After the introduction of a sandy substrate, the dying stopped immediately.

Above: Camouflage is everything!

Eventually, I realized that the young animals were in no danger in the parents' tank. The parents did not eat their fry and, fortunately, the catfishes were not after the little ones either. So I left the next fry in the tank and they grew up very quickly and vigorously. Up to a size of about 2 inches (5 cm), they lived in the pores of a Poret Foam filter. Feeding time was always amusing. As soon as food hit the water, suddenly there were heads looking out from all the pores of the filter sheet. In the parents' tank the babies were also much less anxious and shy.

Husbandry on demand?

Again and again, I am asked how to breed spiny eels. I cannot answer that question because I have never really done anything to get it started. I can only report my observations.

Probably the most important factor is to keep them in a group that contains both sexes. The distinction between the sexes is extremely simple. In males, the ventral side forms a straight line from the head to the body, whereas in females there is a distinct edge or angle. I always say that the females have a double chin. This sexual dimorphism is already clearly visible in juveniles from a size of 3 inches (8 cm). Even if the animals are quite fat (which happens at times in my tanks), in males the straight line remains, while in females the double chin becomes even more prominent.

Below: Slowly, the rostrum begins to grow.

The water parameters seem to play a minor role. In the literature, medium hard water is recommended for *M. maculatus*, but my animals live in very soft water. However, the influence of the water temperature is striking. Courtship begins whenever the temperature rises. I must say that I keep this tank without a heater, so the temperature is usually around 75–77°F (24–25°C). In the summer months, the temperature increases to 81–84°F (27–29°C) and the spiny eels

During his busy search for food, this baby was not even afraid of the camera.

become very active. During the day, they often swim restlessly throughout the tank. The adult pair constantly plays hide and seek, and there is a lot of excitement. The food is probably important and the animals must be well fed. The female soon develops eggs, which can be seen clearly through the abdominal wall. Just over two weeks later, the first larvae emerge, so the adults do not waste any time.

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Aggression

The myth that spiny eels won't breed in the aquarium probably has several explanations. First, many retailers and hobbyists think they should be kept individually because they are aggressive toward each other. I cannot confirm this at all. On the contrary, in a group they are far more outgoing and seem to feel safer.

The rumor that spiny eels are aggressive may have various origins. In my experience, socialization of *M. circumcinctus* with *M. maculatus* leads to the smaller *M. circumcinctus* being constantly chased and bitten. Unfortunately, both *M. maculatus* and *M. circumcinctus* are often offered as "Belted Spiny Eels." They look quite similar, but *M. maculatus* have no stripes on the abdomen and are up to 11 inches (28 cm) long compared to the 7-inch (18-cm) *M. circumcinctus*. Of course, such errors lead to socialization problems that promote the view that spiny eels are aggressive toward each other.

Mastacembelus armatus is supposedly quite aggressive, but I have not determined yet if that is also the case in sufficiently large and well-structured tanks. However, if animals differ significantly in size, there is always friction and the smaller ones get pressed hard. You can avoid this with the purchase of a group of similarly sized animals. A fellow spiny eel keeper has successfully kept *Macrognathus pancalus*, *M. zebrinus*, *M. meklongensis*, *M. linea-tomaculatus*, and *M. aculeatus* in large groups without any significant aggression.

In addition, spiny eels probably only breed if all the parameters are met to some degree. The combination of higher temperatures and lots of good food is important. They are greedy carnivores, not hard to please, and they will take bite-size meaty foods, insect larvae, crustaceans, pieces of mollusk, and the whole gamut of live worms. But sometimes the right weather seems to play a role as well, because during bad summers there are far fewer offspring.

I would argue that one should keep spiny eels in groups, because they are basically social animals. If species are carefully and correctly identified, interspecific socialization and aggression can be avoided. Under the correct circumstances, I hope that many owners are experiencing the spontaneous reproduction that has happened in my tank. The husbandry of spiny eels is really a special experience!

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CALENDAR

compiled by Mary E. Sweeney and Ray Lucas

JUNE

8 — **International Betta Show**
California Betta Society
Santa Clara, CA
www.cbsbettas.org

20–23 — **Show & Auction**
Florida Tropical Fish Expo
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www.flafishshow.com

22–23 — **Show & Auction**
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www.newenglandguppies.org

28 — **Auction**
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www.greatlakescichlidsociety.net

30 — **Auction**
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13 — **Summer Auction**
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http://www.champaignfish.com

13–14 — **Show & Auction**
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www.gaas-fish.net

18–21 — **American Cichlid Assn. Convention**
ACA 2013
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www.2013aca.com

20–21 — **IFGA Sanctioned Show & Auction**
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OCTOBER

10–13 — **60th Diamond Jubilee Event**
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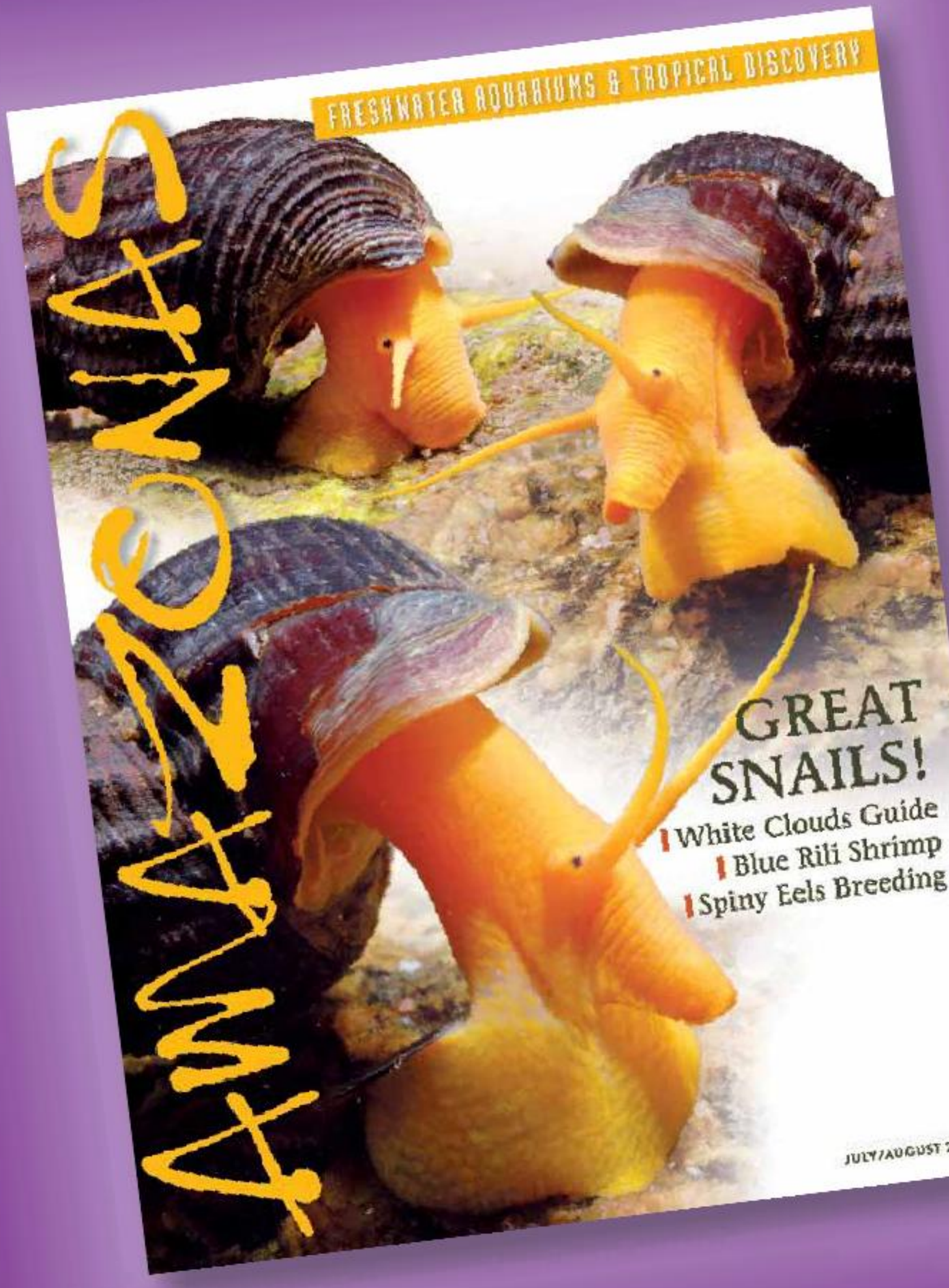
Contact: **mary.sweeney@reef2rainforest.com | Ray Lucas: kingfish51@verizon.net**

"Wow!"



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Shown is the "Yellow Galaxy spade tail," sold under the name "Bumblebee" by Von Wussow. It is just one of the many beautiful, uncommon strains of *Poecilia reticulata* that will soon broaden the range of Guppy varieties available in the pet trade. Tropical fish suppliers in other countries may wish to take note of this trend to bring new life into Guppy keeping.

—Hans-Georg Evers

Two new species of *Nothobranchius*

2 | Two new, very attractive killifishes of the genus *Nothobranchius* were recently described from western Tanzania. In May 2011, two Bulgarian killifish enthusiasts found the new species in the tributaries of the Katuma River.

The first species was described as *Nothobranchius kardashevi* by Valdesalici (2012) in honor of its discoverer, Kiril Kardashev. It belongs to the *N. ugandensis* species complex, a group with a wide range from Sudan and Ethiopia in the north to the drainage of the Bubu River and Lake Rukwa in Tanzania in the south. So far, *N. kardashevi* is only known from a residual pool of the Karira River.

The second species, *Nothobranchius ivanovae*, was described in honor of the second discoverer, Iva Ivanova. It belongs to the *N. taeniopygus* species group, whose

H.-G. EVERS

Nothobranchius kardashevi

Nothobranchius ivanovae

members are widespread across Tanzania and Zambia.

Both species are seasonal. Their eggs survive dry periods for many months.

—Stefano Valdesalici

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Triplophysa siluroides

3 | The first time that I saw this fish, I did not know whether I was dealing with a loach or a catfish. A group of specimens about 8 inches (20 cm) long was bustling about in the cold water department of Pier Aquatics in Wigan, England. Indeed, the scientific species name of this loach actually means "catfish-like." The species-rich loach genus *Triplophysa* is widespread over large parts of China, Kazakhstan, and Uzbekistan. This catfish loach comes from the drainage of the Yellow River ("Huang He" in Chinese). Its head shape resembles that of the South American loach catfishes of the family Trichomycteridae; a nice play of words and also a wonderful example of convergence. It is quite spectacular that for once a representative of these loaches has found its way into the aquarium trade. The care of these agile diurnal animals is relatively straightforward as long as the water temperature is not too high and they are provided with enough space and hiding places.

—Hans-Georg Evers

Triplophysa siluroides, the "Catfish Loach"

TOP TWO: I. IVANOVA; BOTTOM: H.-G. EVERS

Male *Rhinogobius formosanus*, Taiwan Goby

Taiwan Goby, *Rhinogobius formosanus*

4 | Many new species of *Rhinogobius* have entered the hobby in recent times from Taiwan. One is *Rhinogobius formosanus* Oshima, 1919, from northern and northeastern Taiwan. For a time, the species had been considered a subspecies of *R. nagoyae* because it is very similar to that species. In the more recent literature, *R. formosanus* has again been considered a separate species. *R. formosanus* belongs to the larger-growing *Rhinogobius* species and is assigned to the *R. brunneus* species complex. Particularly striking is its pretty head pattern and a long filament on the anterior dorsal fin.

In the aquarium, as is usual for this genus, the species is best kept on finely grained substrate with large, flat rocks laid on top. These gobies prefer to dig caves under the rocks and lay their eggs there. *R. formosanus* is one of the species that lay very numerous and very small eggs.

—Michael Taxacher

Hemigrammus sp. "Colombia"

5 | Colombian exporters have obviously recognized that there are a large number of very interesting tetras in their country and that exporting them is lucrative. In late October, Pier Aquatics (Wigan, UK) imported a shipment of these pretty tetras from Colombia, unfortunately without precise locality information. At first glance, they resemble *Hemigrammus ocellifer*, the Head-and-Taillight Tetra. The new species has a glowing stripe along the body flanks and the lateral spot is below the lateral line, flanked by a golden spot. The upper caudal lobe turns slightly reddish, which is intensified if kept in low light and soft, slightly acidic water.

This approximately 1.6 inch (4 cm) long, very attractive tetra is, hopefully, only the first of a future series of new fishes from Colombia. Since the guerrillas have become quieter in that country, fish collectors again dare

A pair of the new *Hemigrammus* sp. tetras from Colombia.

to mount excursions into areas that have been very dangerous for decades.

—Hans-Georg Evers

Tachysurus spilotus

6 | Only last year, the famous ichthyologist H.H. Ng described a new representative of the Asian catfish genus *Tachysurus* (family Bagridae) from the Da Nang province in central Vietnam. The Imazo company in Göteborg, Sweden, has now managed to import some specimens of this 3.2 inch (8 cm) catfish for the first time.

Tachysurus spilotus is apparently not very common in its home country and not many specimens are known to science, either. Vietnam has increasingly become a focus for ichthyologists, and it remains to be seen what else avid explorers will discover.

Some smaller species of Bagridae, such as the pretty *Hyalobagrus flavus*—perhaps better known under the false name *Pelteobagrus ornatus*—are ideal for smaller aquariums. Whether this also applies to *T. spilotus* has yet to be determined. If you encounter this fellow in a pet shop among imports from Vietnam, at least you can now properly determine the species.

—Hans-Georg Evers

Tachysurus spilotus, a new, distinctively patterned bagrid catfish from Vietnam.

REFERENCES

Ng, H.H. 2009. *Tachysurus spilotus*, a new species of catfish from central Vietnam (Teleostei: Bagridae). *Zootaxa* 2283: 16–28.

OPPOSITE PAGE, TOP: M. TAXACHER; BOTTOM AND THIS PAGE: H.-G. EVERS

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NATIONAL AQUARIUM CLUBS

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www.cichlid.org

American Killifish Association
www.aka.org

American Livebearer Association
www.livebearers.org

The Angelfish Society
www.theangelfishsociety.org

Aquatic Gardeners Association
www.aquatic-gardeners.org

International Betta Congress
www.ibcbettas.org

International Fancy Guppy Association
www.ifga.org

Mid-Atlantic Koi Club
www.makc.com

North American Discus Association
www.discusnada.org

The North American Native Fishes Association
www.nanfa.org

Northeast Council of Aquarium Societies
www.northeastcouncil.org/nec/

ARIZONA

Dry Wash Aquarium Society, Phoenix
www.DryWashAquarium.org

Arizona Aquatic Plant Enthusiasts (AAPE)
Tuscon & Phoenix
www.azaquaticplants.com/index.php

CALIFORNIA

Sacramento Aquarium Society
Sacramento
www.SacramentoAquariumSociety.org

San Francisco Aquarium Society
San Francisco
www.SFAquarium.org

Silicon Valley Aquarium Society
San Jose
www.SiliconValleyAquariumSociety.com

COLORADO

Colorado Aquarium Society, Arvada
www.ColoradoAquarium.org

Rocky Mountain Cichlid Association
Denver
www.rmcichlid.org

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Greater Hartford Aquarium Society
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www.GHASCT.org

Northeast Livebearer Association
Bristol
www.nela.northeastcouncil.org

Norwalk Aquarium Society
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www.NorwalkAS.org

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Gold Coast Aquarium Society of South Florida, Cooper City
www.GCAquarium.org

Tampa Bay Aquarium Society, Tampa
www.TBAS1.com

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Atlanta
www.AtlantaAquarium.com

HAWAII

Honolulu Aquarium Society, Honolulu
www.HonoluluAquariumSociety.org

ILLINOIS

Central Illinois Tropical Aquarium Club (CITAC)
Bloomington
www.citac-il.org

Federation of American Aquarium Societies
Champaign
www.FAAS.info

Greater Chicago Cichlid Association
Brookfield
www.GCCA.net

Green Water Aquarist Society, Alsip
www.GWASOC.org

INDIANA

Circle City Aquarium Club
Indianapolis
www.CircleCityAqClub.org

Michiana Aquarium Society, South Bend
www.MichianaAquariumSociety.org

IOWA

Eastern Iowa Aquarium Association
Cedar Rapids
www.FinFlap.com

LOUISIANA

Southeast Louisiana Aquarium Society
Baton Rouge & New Orleans
www.selas.us

MARYLAND

Capital Cichlid Association, Silver Spring
www.CapitalCichlids.org

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Boston Aquarium Society, Boston
www.BostonAquariumSociety.org

Pioneer Valley Aquarium Society
Chicopee
www.PVAS.net

Worcester Aquarium Society, Worcester
www.WorcesterAquarium.org

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www.GreaterDetroitAquariumSociety.org

Grand Valley Aquarium Society
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www.GrandValleyAquariumClub.org

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www.SWMAS.org

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Minnesota Aquarium Society
Roseville
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Missouri Aquarium Society, St. Louis
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New Hampshire Aquarium Society
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www.NHAquariumSociety.com

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Jersey Shore Aquarium Society
Freehold
www.JerseyShoreAS.org

North Jersey Aquarium Society, Nutley
www.NJAS.net

NEW YORK

Allegheny River Valley Aquarium Society
Olean
www.orgsites.com/ny/ARVAS

Brooklyn Aquarium Society, Brooklyn
www.BASNY.org

Danbury Area Aquarium Society (DAAS)
Carmel
www.northeastcouncil.org/daas

Central New York Aquarium Society
Syracuse
www.CNYAS.org

Genesee Valley Koi & Pond Club
Rochester
www.ggw.org/GVPAKE

Greater City Aquarium Society, Flushing
www.GreaterCity.org

Long Island Aquarium Society
Stony Brook
www.LIASOnline.org

Thanks to Ray "Kingfish" Lucas of Kingfish Services in Boston, NY, for his invaluable help in establishing this directory and the *AMAZONAS* Aquarium Calendar of Events. www.kingfishservices.net

Nassau County Aquarium Society
Rockville Center
www.NCASweb.org

Niagara Frontier Koi & Pond Club
North Tonawanda
www.NFKPC.org

Tropical Fish Club of Erie County
Hamburg
www.Tropical-Fish-Club-of-Erie-County.com

NORTH CAROLINA

Raleigh Aquarium Society, Raleigh
www.RaleighAquariumSociety.org

OHIO

Cleveland Aquarium Society, Cleveland
www.ClevelandAquariumSociety.org

Columbus Area Fish Enthusiasts
Plain City
www.ColumbusFishClub.org

Greater Akron Aquarium Society, Akron
www.GAAS-FISH.net

Great Lakes Cichlid Society, Euclid
www.GreatLakesCichlidSociety.net

Medina County Aquarium Society
Medina
www.geocities.com/MCASfish/index

Ohio Cichlid Association, Brunswick
www.OhioCichlid.com

Stark County Aqua Life Enthusiasts Society, Canton
www.ClubScales.com

Youngstown Area Tropical Fish Society
Youngstown
www.YATFS.com

OREGON

Greater Portland Aquarium Society
Clackamas
www.GPAS.org

PENNSYLVANIA

Aquarium Club of Lancaster County
Lancaster
www.ACLCPA.org

Bucks County Aquarium Society
Chalfont
www.BCASOnline.com

Greater Pittsburgh Aquarium Society
Pittsburgh
www.GPASI.org

TEXAS

Houston Aquarium Society, Houston
www.HoustonAquariumSociety.org

VERMONT

Tropical Fish Club of Burlington
Burlington
www.tfcb.org/

VIRGINIA

Central Virginia Aquarium Society
Richmond
www.CVAS.forumotion.com

Potomac Valley Aquarium Society, Fairfax
www.PVAS.com

WASHINGTON

Greater Seattle Aquarium Society
Seattle
www.GSAS.org

Puget Sound Aquarium Society
Federal Way
www.thePSAS.org

WISCONSIN

Milwaukee Aquarium Society, Milwaukee
www.MilwaukeeAquariumSociety.com

Central Wisconsin Aquarium Society
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www.cwas.org

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www.angfa.org.au/

New South Wales Cichlid Society
Moorebank, NSW
www.NSWCS.org.au

Victorian Cichlid Society Inc.
Mitcham, VIC
home.vicnet.net.au/~cichlid

Queensland Cichlid Group Inc.
Clayfield, QLD
www.qcichlid.org

BERMUDA

Bermuda Fry-Angle Aquarium Society
www.fryangle.com

CANADA

The Canadian Association of Aquarium Clubs
Canada & New York State
www.caoac.ca

London Aquaria Society
London, ON
www.londonaquariasociety.com

Saskatoon Aquarium Society
Saskatoon, SK
www.SaskatoonAquarium.com

Montreal Aquarium Society, Montreal, QC
www.theMontrealAquariumSociety.com

Hamilton & District Aquarium Society
Hamilton, ON
www.HDAS.ca

Durham Region Aquarium Society
Oshawa, ON
www.DRAS.ca

Regina Aquarium Society
Regina, SK
www.reginaaquariumsociety.ca

Association Regionale des Aquariophiles de Quebec, Ste-Foy, QC
www.ARAQ.org

Aquarium Society of Winnipeg
Winnipeg, MB
www.ASW.ca

FINLAND

Ciklidistit r.y. (Finnish Cichlid Association), Vantaa
www.aquahoito.info/cichlids/index.html

FRANCE

Association France Cichlid, Hoenheim
www.FranceCichlid.com

GERMANY

Deutsche Cichliden-Gesellschaft
(German Cichlid Society)
Frankfurt am Main
www.DCGonline.de

MALAYSIA

Malaysia Guppy Club
www.myguppy.net

MALTA

Malta Aquarist Society
Attard
www.maltaaquarist.com/

SINGAPORE

Discus Club Singapore
www.DiscusClubSG.com

UNITED KINGDOM

Anabantoid Association of Great Britain
Doncaster
www.AAGB.org

BIDKA: The British and International Discus Keepers Association
www.BIDKA.org

Bristol Aquarists' Society, Bristol
www.bristol-aquarists.org.uk

The Federation of British Aquatic Societies, Sussex
www.FBAS.co.uk

Greater Manchester Cichlid Society
Greater Manchester
www.nekrosoft.co.uk/GMCS

The Calypso Fish and Aquaria Club
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www.calypso.org.uk

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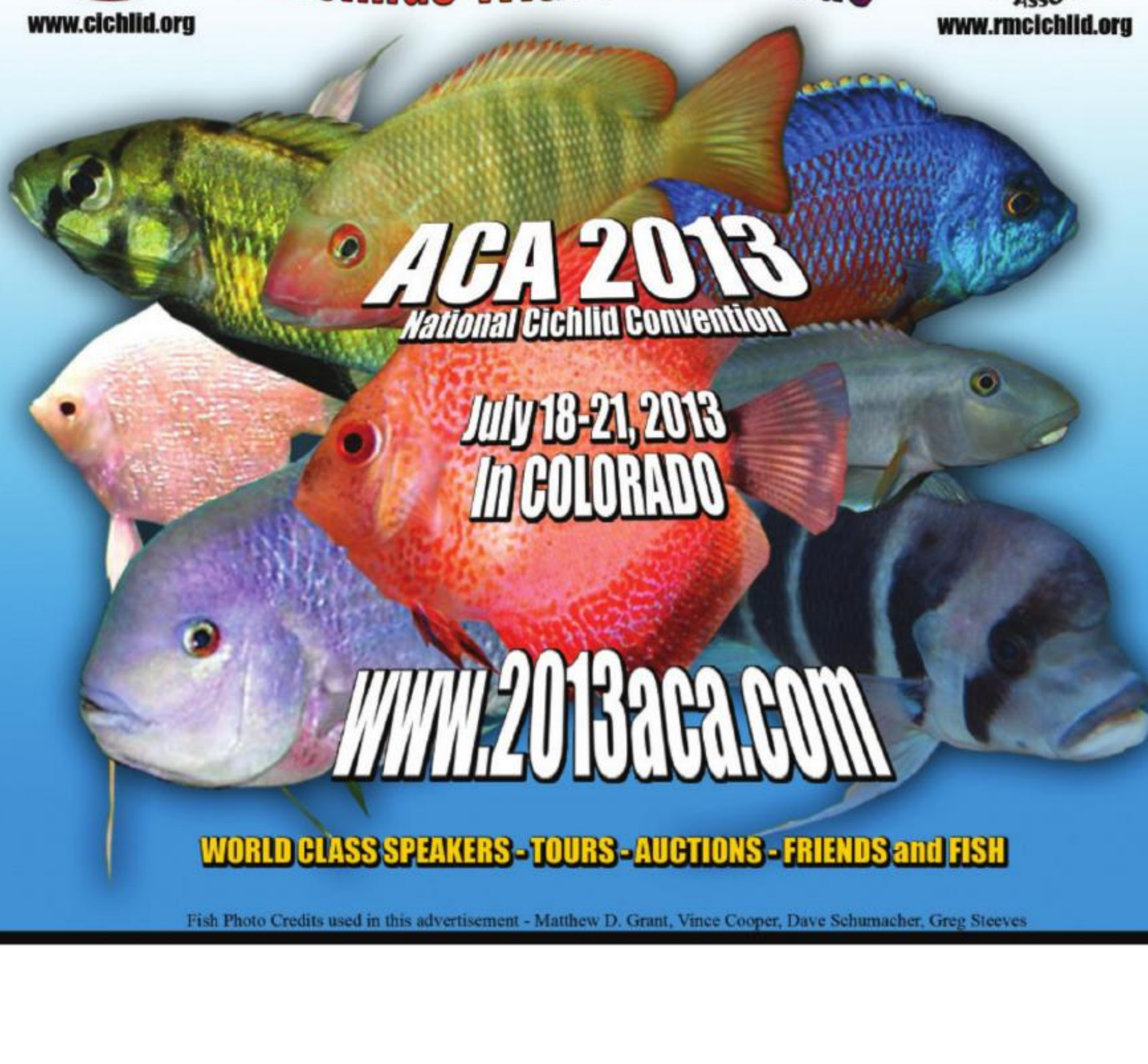

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