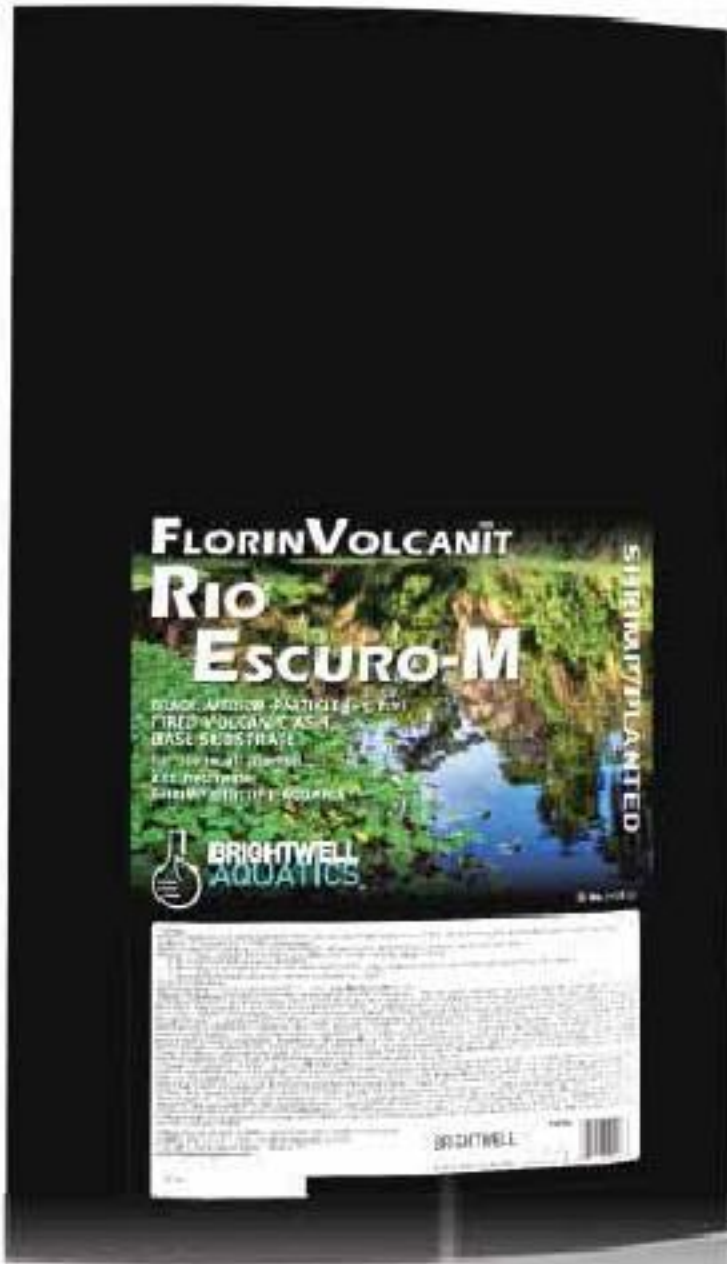


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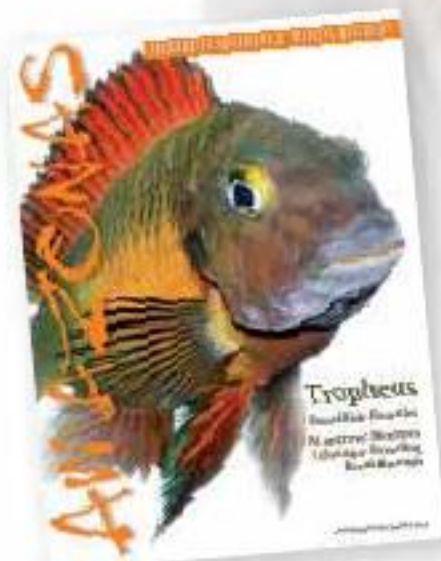
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ED  
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AMAZONAS



Dear Reader,

Which aquarist category do you belong to? Perhaps you joke about the “eggcoals” (egg-shaped charcoal briquettes, aka *Tropheus*) of Lake Tanganyika and wonder why some find these fish interesting—they buzz all day through the tank, delivering blows to the left and right, and immediately swim up to the front glass in hopes of receiving something edible. Or you might be a real fan of these fantastically colored cichlids, which demand quite a bit of care if you understand and maintain them appropriately.

I won't tell you which category I fall into, but during the preparation of this issue I have learned that the care and breeding of *Tropheus* species is a hobby within a hobby and requires a lot of patience and dedication. *Tropheus* devotees have an incredible understanding of their favorites and are usually faithful to them all their lives.

Luckily, we have convinced some of these experts to share their knowledge with you. Regular AMAZONAS contributor Norbert Knaak has been an aquarist since early childhood and has fallen in love with the cichlids of the African rift lakes. Norbert provided helpful advice and stood by me during the preparation of this issue.

In addition to the featured topic, we have some truly breathtaking reports about successful maintenance and breeding that will appeal to the friends of unusual fishes. I cannot tell you how surprised I was when I was contacted by a reader who told me that a species of Royal Pleco has successfully been bred in captivity (Aquatic Notebook, page 6).

*Panaque* cf. *armbrusteri*, aka L 27, is one of the most desirable plecos we have in the hobby. Many people were convinced that these big fish would never tell us how they do it. Well, Taiwanese aquarist Stephen Huang did it, and we are lucky enough to be able to tell our readers about it. What a great example of the abilities of aquarists nowadays!

English edition readers will find a visual feast in Flick Ford's glorious fish portraits. Mo Devlin ponders the future of robot-filled aquariums, and Devin Biggs shows how he created an inspiring, exotic brackish-water mangrove swamp biotope.

Have fun and enjoy the issue!

A handwritten signature in black ink, appearing to read 'Flick Ford', is written in a cursive style.

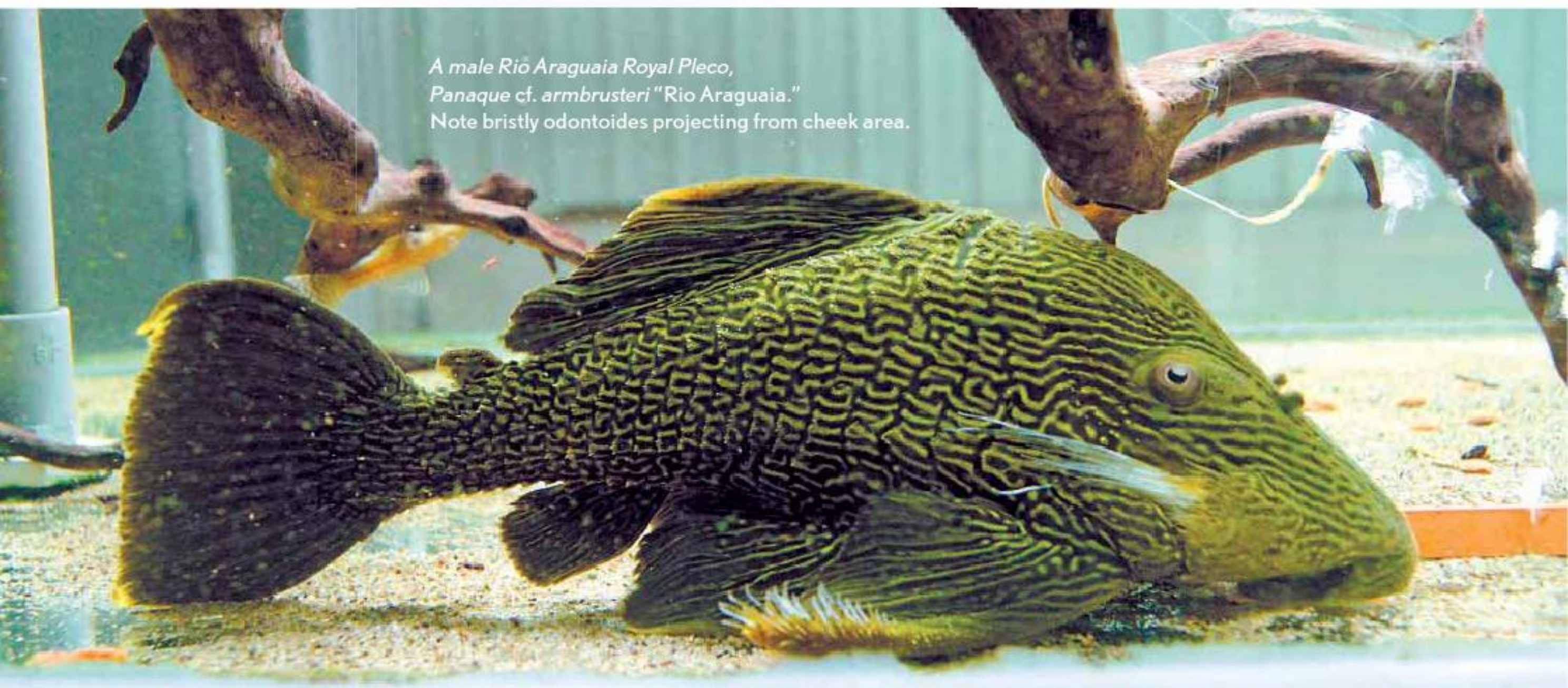


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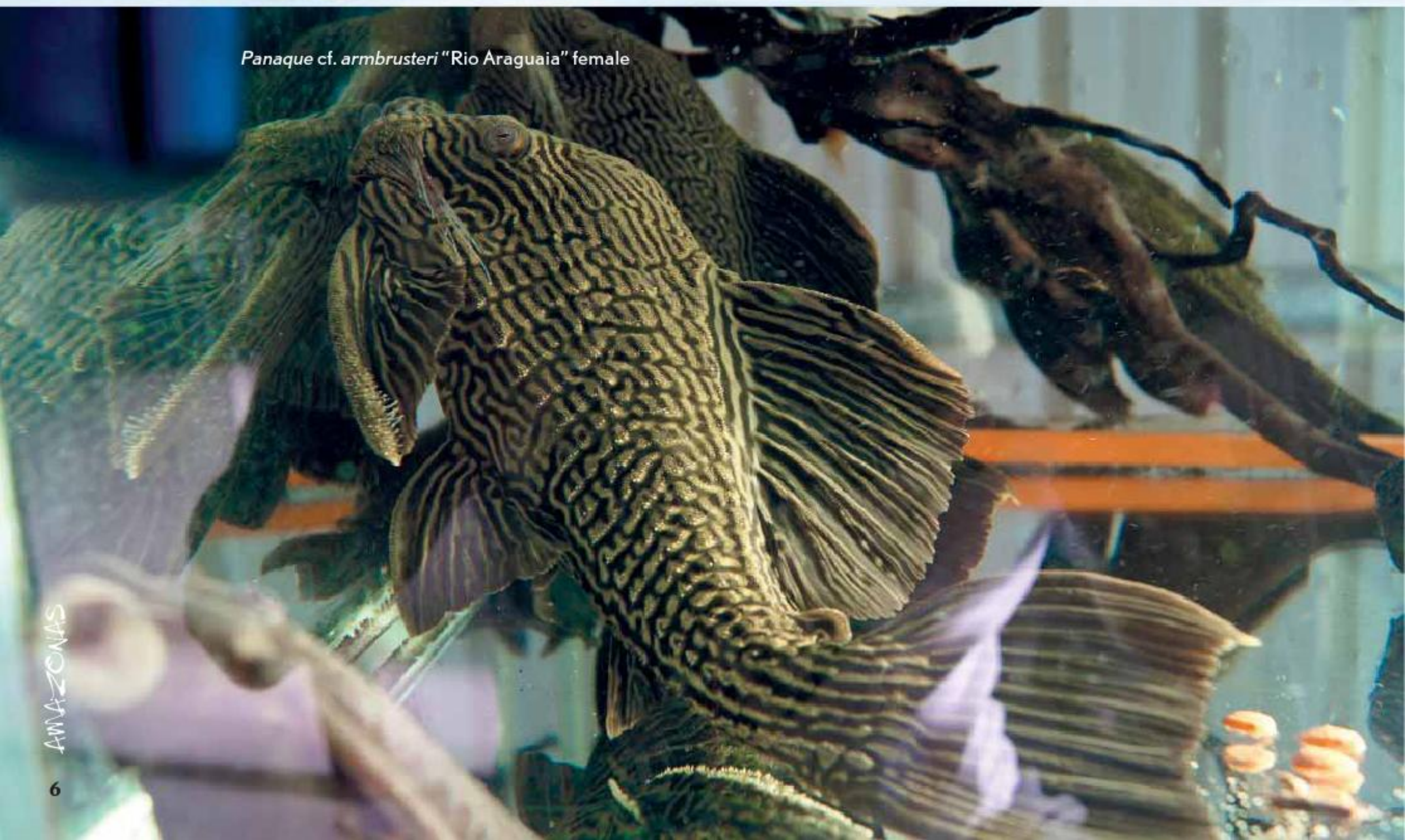
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## BREEDING BREAKTHROUGH: First success with Royal Plecos

A male Rio Araguaia Royal Pleco,  
*Panaque cf. armbrusteri* "Rio Araguaia."  
Note bristly odontoides projecting from cheek area.



*Panaque cf. armbrusteri* "Rio Araguaia" female



*article and images by Stephen Huang* • My first encounter with a large pleco occurred on an ordinary afternoon a decade ago. On that fantastic day, I was strolling aimlessly through the streets; however, I was soon attracted by a huge-headed and gorgeous fish in the front of an aquarium store. It had flame-red eyes and featured a black and golden stripe pattern. Yes, it was an L190, or *Panaque nigrolineatus*, my first Royal Pleco. Because of this adorable and beautiful fish, I embarked on the road of keeping pleco catfishes, and I began to investigate them.



The male drives the female into the cave.

Agriculture, exploitation of natural resources, and pollution are devastating the Amazon rainforest, this treasured ecosystem that is home to so many species. Moreover, climate change, with extreme drought and flooding, has drastically reduced the natural flora and fauna. Hence, captive breeding has become an urgent pursuit for humans, who want to keep and restore threatened species.

In the history of pleco breeding, breeders have mostly focused on small and medium-sized species because they are easier to maintain in smaller tanks. Since their maturation time is shorter, a new generation of broodstock fish can again reproduce more quickly. On the other hand, the large-sized plecos grow slowly and take several years or even a decade or more to mature. Therefore, they are much

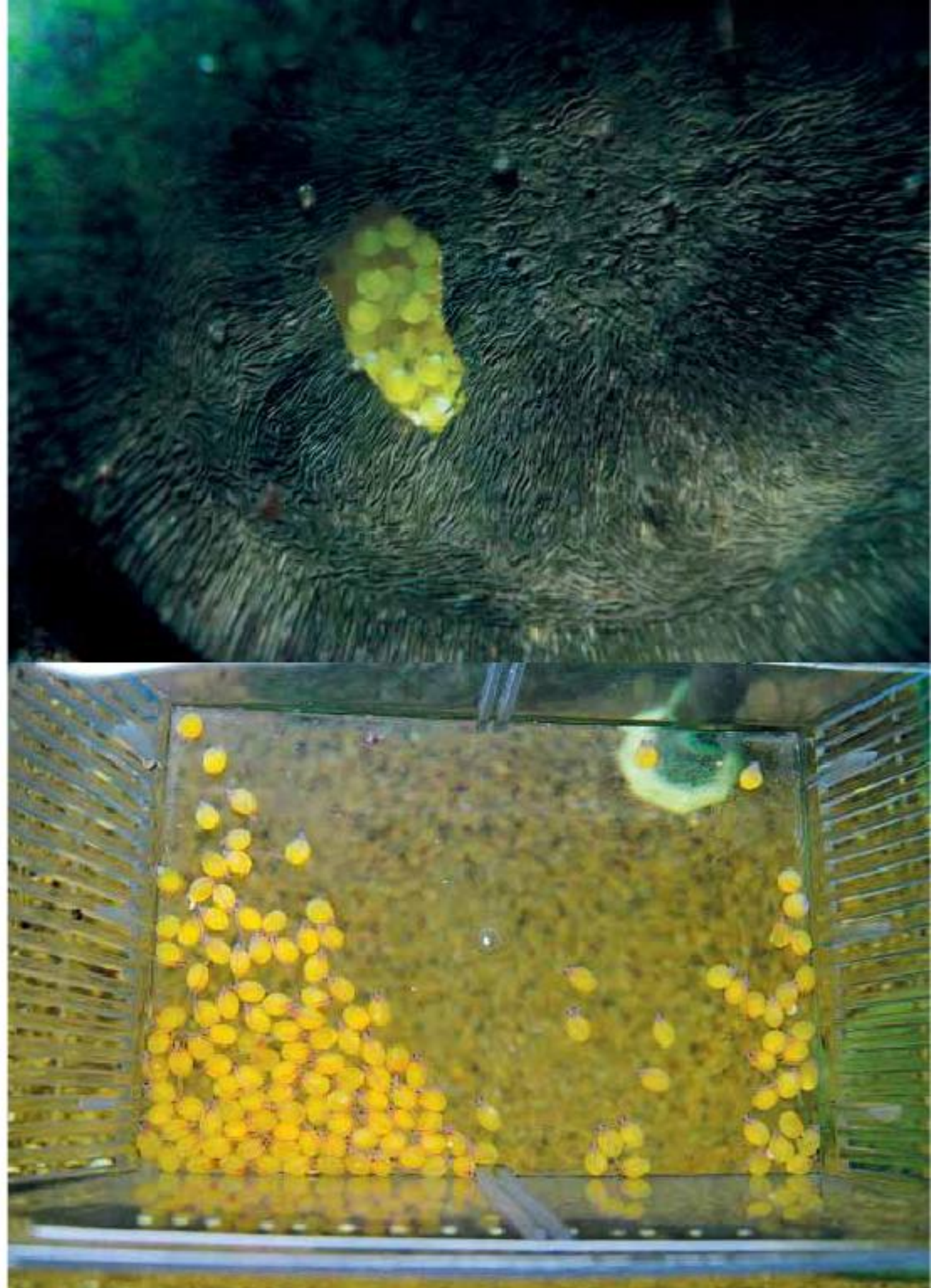
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more difficult to breed than small and medium-sized plecos. Nonetheless, in recent years we have seen some successful cases of breeding various large-sized plecos such as *Pseudacanthicus* spp. (L24, L25, L600, etc.), *Scobinancistrus* L14, and *Hypostomus luteus*, and some of these species are now even bred in the second generation. This exciting news inspires pleco-keepers like me. However, so far there are no documented records in the literature on the successful breeding of *Panaque* spp., much less how to raise their fry.

### Introduction

Like other ancistrine plecos, when *Panaque* spp. become mature they develop readily noticeable interopercular odontodes (dermal teeth) behind the operculum, as well as on the pectoral fin spines. These characteristics can be significantly different between male and female, but the development of odontodes is variable among plecos. In *Panaque* spp., the huge, broad body, together with the imposing interopercular odontodes and spiny extensions on the pectoral fins, make them look truly majestic, as shown in the photos on the previous two pages.

*Panaque* cf. *armbrusteri* "Rio Araguaia" plays the main role in this article. These fish come from the Rio Araguaia in Brazil, which is the main tributary to the Rio Tocantins. This fish has a tall head and a broad body with glossy



Opposite page, top:  
Developing eggs in the  
cave as seen through a  
small hole in the back.

Opposite page,  
bottom: Newly hatched  
*Panaque cf. armbrusteri*  
"Rio Araguaia."

Left: Babies about  
a week old, still with  
yolk sac.

black and green-golden stripes, which makes it one of the most attractive and popular species of *Panaque*. In captivity, the body color can vary due to the fish's rank in a tank, and the lowest ranking individuals may even turn pale.

It is difficult to sex *Panaque* spp. because the male and female show few obvious sexual differences, whether they are juveniles or adults. Both sexes grow the interopercular and pectoral fin odontodes when they are mature. When we put a putative pair of brood fish in a tank, we have to watch closely to see if they fight for dominance. If the stronger individual continues to chase and beat the weaker one, we must remove one of them quickly; otherwise, the weaker fish might die in the worst-case scenario. Pictures of males and females are shown on the previous pages.

### Environment and parental fish

The parental fish were kept and fed in a 90-gallon (350-L) tank, where they were the only residents. The male measured about 13 inches (32 cm) and the female was 11.4 inches (28.5 cm) long. The pH was 7.2 and the temperature was kept around 79-82°F (26-28°C). A third of the water volume was changed every week. The tank was near a window, providing natural light. Except for feeding in the evening, they were not disturbed all day long.

### Mating

Initially, the male searched for a suitable cave for his lair. After he found one he arranged the surrounding environment into an arc shape so he could overlook the space. Once he settled down, he

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Lots of babies! The author's first spawning yielded a hatch of 600 tiny Royal Plecos.

started to wave his fins to attract the female.

When the female appeared near the cave, the male moved close to her. The ensuing interaction looked a lot like fighting at first, but when they had mated successfully the aggression abated and they lived together near the cave.

During the breeding season, the male and female both grew their odontodes. The male repeatedly drove the female into the cave and blocked her exit. This process went on for weeks and even up to a month, until the female finally spawned.

After spawning, the male took on the responsibility of taking care of the eggs until they hatched. During this period, the male waved his fins in the cave to ensure the proper circulation of water. He also turned the eggs as other plecos do and, apparently, ate the unfertilized eggs.

### Raising the fry

The eggs hatched after five days and some of the fry came out of the cave through the small hole in the back (see pages 8-9). Therefore, I moved the fry to another tank with the same water conditions. I counted a total of about 600 babies.

Two days after hatching, black pigment spots started to emerge on the bodies of the developing babies. The yolk sac was completely absorbed after 15 days. Then

the fry started to eat and their bodies turned completely black. Maintaining water quality during this time appeared to be critical, because some of the babies that did not develop normally started to die. Water pollution from dead fish can cause fungal growth and daily cleanup patrols are essential.

After nearly a month, the fry started to develop a golden background color beneath the dark pigment. However, poorly developing individuals still kept dying. Fortunately, the situation finally seemed to stabilize during this period. The babies now started to show a yellow diamond-shaped pattern and looked a bit like a golden version of *Panaque* sp. L330.

When the fry were three months old, their body shape resembled that of their parents, and the spots gradually merged and turned into stripes. The lines on the abdomen started to develop during this period as well. Most juveniles were about 1.2 inches (3 cm) long at that time, and they would rapidly grow to a length of 2-2.4 inches (5-6 cm).

### Postscript

I am delighted to share this breeding report of a *Panaque* spp. with other pleco-keepers. The photographs shown in the article were taken during the second successful spawning and raising of the fry. These fish seem to spawn

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Above: Light background color develops under the dark pigment.

Left: At three months old, the spots turn into stripes.

Below: The abdominal pattern also develops at around three months.

at a specific time every year. Maintaining such a gorgeous species is definitely worth the effort required.

The most significant factors for raising the fry are water conditions and temperature control. Because there are so many babies, there is a lot of waste and leftover food that significantly affect the quality of the water. Drastic changes in temperature will also have an adverse effect on water quality and cause problems. To avoid this use good, reliable equipment. Think twice before attempting breeding: the novelty soon wears off, and your fish have the right to survive. 🐟





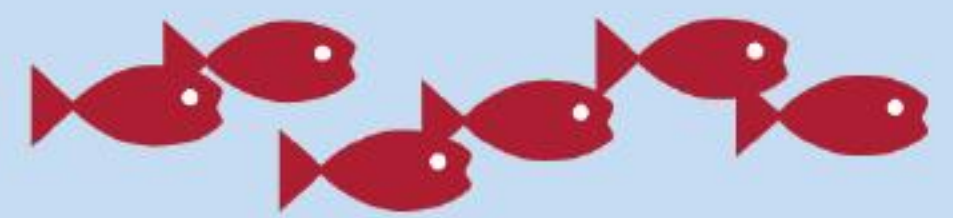
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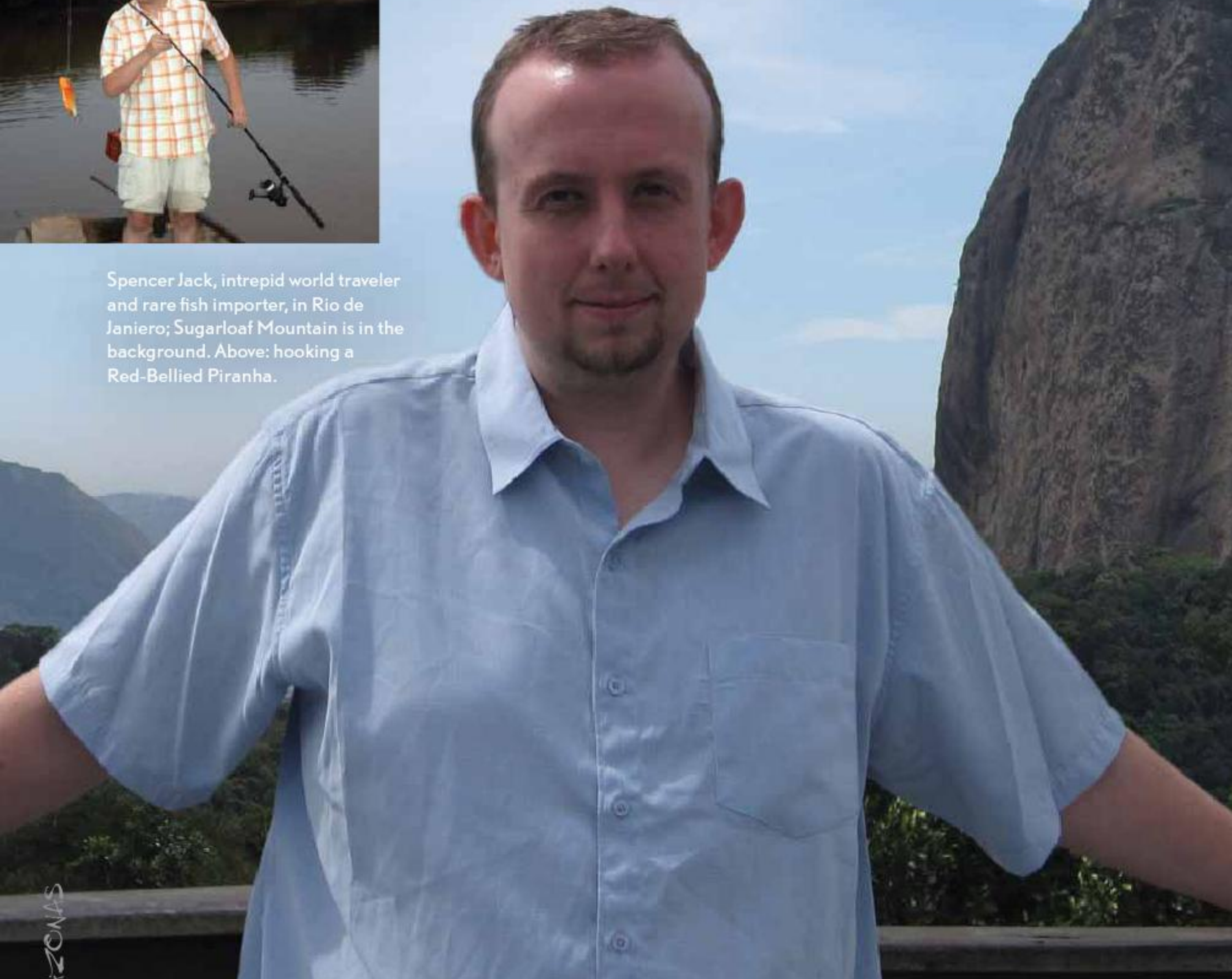


## Traveling the Fish Scene:

# Spencer Jack



Spencer Jack, intrepid world traveler and rare fish importer, in Rio de Janeiro; Sugarloaf Mountain is in the background. Above: hooking a Red-Bellied Piranha.





*Dimidichromis kiwinge* at Spencer Jack's Winnipeg, Canada, facility, aFISHionados.

by Rachel O'Leary • A sprawling prairie city in the Great White North hardly seems a likely mecca for rare fish enthusiasts, but I met Spencer Jack, a world-renowned figure in the freshwater livestock trade, here in Winnipeg when I came to speak to an elite group of enthusiasts known as the Dead Fish Order, a nonprofit of which Jack is a founding member.

Unlike most clubs, this group collects no membership dues but treats each meeting as an event, bringing in speakers to expound on a broad range of topics and selling a predetermined number of tickets. The Dead Fish Order is known for its stellar speaker lineup and for conservation efforts like the Malawi Goat Fund, which Jack started with Chris Biggs. The fund works through a certified Canadian charity to donate goats to impoverished families on Lake Malawi. The animals provide income as well as fresh milk, meat, and manure for fertilizing crops, and the fund's slogan is "Save our fish, eat a goat."

Those of us who keep cichlids are familiar with Jack, a popular speaker at annual American Cichlid Association conventions and at regional clubs and events around the world. He is also the owner of The aFISHionados, a wholesale tropical fish business in Winnipeg, Manitoba, that is open to the public. I met with him at his warehouse, where he introduced me to some of his livestock acquisitions.



*Tropheops* sp. "Red Cheek"

Jack has been in business for nine years and currently has more than 375 tanks containing over 17,000 gallons in his warehouse. There are three main aisles, each of which has three tiers of tanks with stock tubs underneath. Each tank has a Poret foam filter (mattenfilter), and water flow is powered by a central air blower. The warehouse is a very impressive space chock full of freshwater fishes, from livebearers, Goldfish, Koi, and all kinds of cichlids to invertebrates, including shrimps and snails, and live aquatic plants.

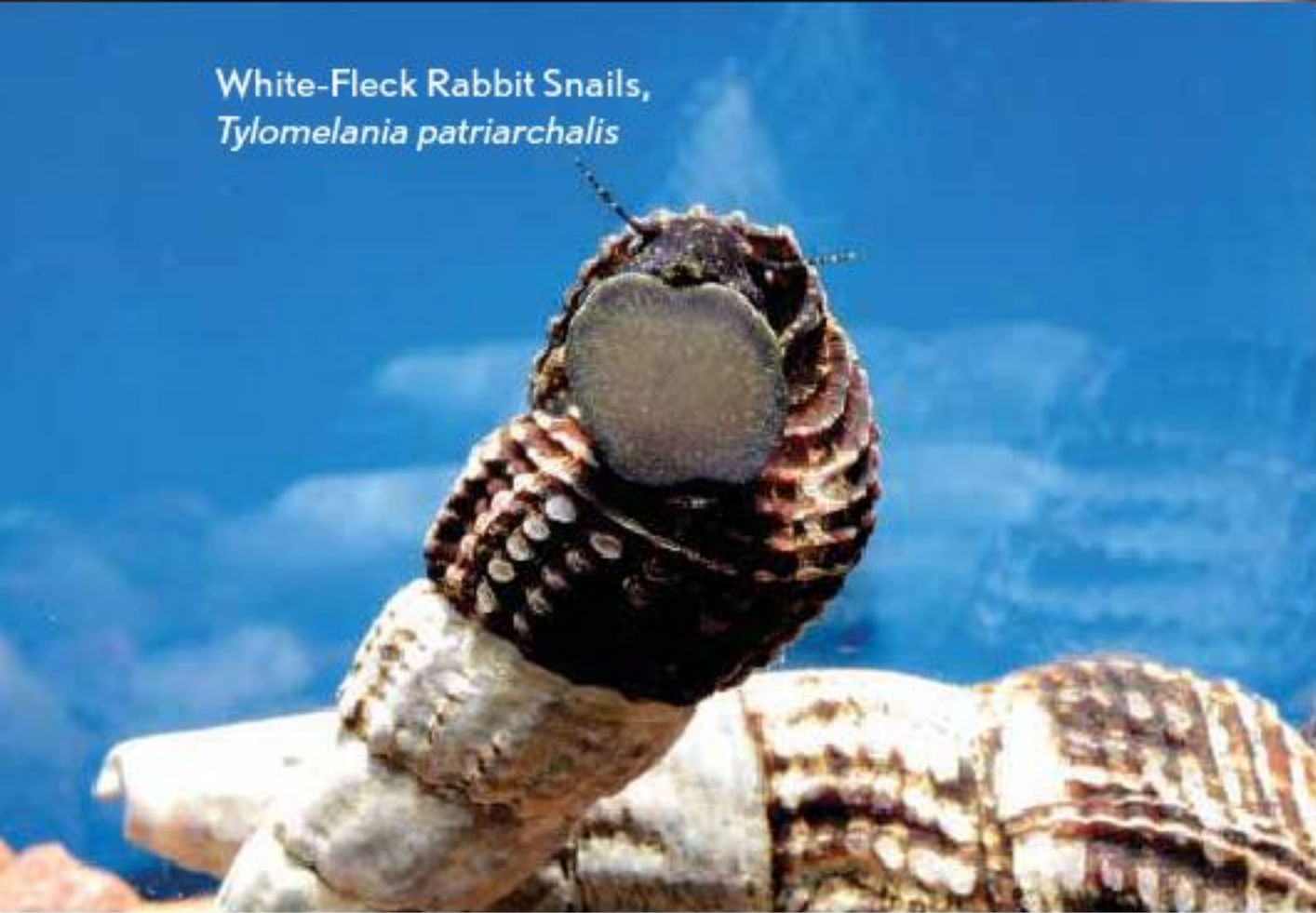
I was excited to see that Jack had species still new to the United States, including a wide range of *Tylomelania* spp. snails and very unusual species of shrimp, like Snow Bees and many of the newest color forms of *Neocaridina*. I was especially stoked to see Asian arowanas and many of the *Channa* (snakehead) species that are illegal to keep in the United States.



Blue-Eyed Pleco, *Panaque cochliodon*



Golden or Assamese Snakehead, *Channa stewartii*



White-Fleck Rabbit Snails, *Tylomelania patriarchalis*

### Amateur beginnings

Jack got started in the hobby early. At the tender age of 12, he and six other individuals founded the Aquarium Society of Winnipeg. He co-founded the Canadian Cichlid Association at age 25, and just last year he co-founded the Dead Fish Order.

He has bred hundreds of species of fish, predominantly cichlids, and considers members of the Cyphotilapia family to be the most rewarding—the AFISHionados logos feature a Frontosa Humphead Cichlid. During his university days, his entire basement fishroom was dedicated to housing dozens of cichlid colonies. Jack points out that while it isn't always difficult to get fish to spawn,

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Jack travels 125,000 miles a year to meet collectors and exporters of coveted species, such as this Polka Dot Ray, *Potamotrygon leopoldi*.



many of the larger New World cichlids that pair-bond can wreak havoc in a tank, and the space requirements are considerable—not just for adult pairs but for the huge numbers of fry that they regularly produce. He finds Lake Tanganyika cichlids especially appealing and says that a properly set up tank of *Cyathopharynx fuae* or *Enantiopus* sp. “Kilesa” are his among his favorites.

While I was at the AFISHionados store, Jack noted that customers were going crazy over Electric Blue Jack Dempsey Cichlids. “My favorites are rarely those that are

wildly popular in the hobby,” he says, “so I try to match the customer to the appropriate fishes rather than pushing any one trendy fish or aspect of the hobby. For me, finding a dream fish is often the most rewarding part of the search.”

Jack uses a very personalized approach in his interaction with a number of Florida fish farms, too. He has a face-to-face relationship with everyone from whom he imports fishes, be they wild or domestic. He says he travels “in excess of 125,000 miles a year” and has done so



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for at least the past 10 years. "A contextual understanding of the source and its shortcomings or strengths is integral to the way we handle fishes at my facility," he says.

Jack also makes sure that trade names are kept current, and is often surprised to see that many species thought to be unavailable are still being bred under an outdated name. "One of the most unique experiences a hobbyist can have is to go to a South American country loaded with cool species of fish and visit a local pet store filled with platies, Goldfish, and assorted Lake Malawi cichlids—or a sign at the door proudly stating that all fishes are imported from Florida."

Jack believes that knowing the market is the key to opening up both sides of the industry. Many countries

rich in tropical fishes have limited shipping routes or no official exporters, so he spends time establishing connections in order to make those species commercially available and to help preserve natural habitats by establishing breeding populations.

When asked about his extensive travel, Jack says that his favorite place to explore new species is Uruguay. He attributes this preference mostly to his host, Felipe Cantera, but also to the food, the weather, and the rich diversity of fish. He has traveled to four continents to speak at fish-related events, and says that picking a favorite is tough. "Most notable are Australia, where hobbyists' dedication and investment are astounding; Montevideo, with its amazing hospitality, where the barbecue

can make an attendee almost forget he is there for the fishes; and Bermuda, which has one of the smallest but one of the most gracious groups of fish-keepers I've ever encountered."

Jack continues, "Each fish event amongst friends with similar interests can be a special occasion. You really have not fully experienced fish-keeping until you travel to meet others who share your passions."

Jack is always working on breeding new species and expanding his network of suppliers. Being in the center of Canada, with its decidedly untropical environment, has its own unique set of weather and transportation challenges, but he remains committed to offering a wide variety of fishes to as many hobbyists as possible.

"Finding the fishes is only half the challenge. Getting them to Winnipeg alive in the middle of a Canadian winter can be a mind-boggling experience."

Sustainable aquaculture is becoming more important each day, given the continuing destruction of habitat, the introduction of invasive species, and the difficulty and legal challenges of importation. Jack's devotion to the hobby and his close connections with Florida fish farms promote a sense of security with regard to the sources of our fishes. 🐟

**Rachel O'Leary** is the owner of *Invertebrates by Msjinkzd* in Mount Wolf, Pennsylvania, <http://msjinkzd.com/>.

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# 24/7



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# GETTING HOOKED



*article and images by Norbert Knaak* • If you Google “*Tropheus*,” you will come up with over 750,000 results. In forums on the Internet about the cichlids of the East African rift lakes, these fish are the most widely discussed topic, and the number of websites dedicated to them is almost overwhelming. This issue is dedicated to *Tropheus* to reveal tips and tricks learned through decades of keeping them—and, quite possibly, to pique your interest in these wonderful fishes.

I had my first contact with *Tropheus* cichlids 30 years ago at Willi Ove’s pet store in Flensburg, Germany. When three small, pitch-black fish covered with white dots gazed at me from behind the glass, I practically gasped. I still remember the look on my friend’s face when I bought them for 16 German marks each, a sizable amount for a student at that time.

I had already gained some experience in the care and breeding of various South American and African cichlids. I also had a good collection of books, but there was not much known about *Tropheus*.



One of the author's *Tropheus* tanks, aquascaped with river stones and an open sandy area in the foreground.

# ON *Tropheus*

As usual, the first thing I did was feed them. After all, these were cichlids, so they needed something hearty to eat! Anyone who has ever kept *Tropheus* cichlids can guess how that story ended. I still have the greatest respect for the single animal who did not immediately die from being fed the wrong foods. Still, I was hooked on these fish. After some searching, I found a *Tropheus* breeder in Schleswig who infected me forever with the *Tropheus* fever.

## Unpredictable aggression

The genus *Tropheus* is endemic to Lake Tanganyika. So far, at least eight species have been discovered there. Quite a few forms cannot be clearly attributed to the known spe-

cies and await scientific description. There are about 80 variants, and I would like to briefly introduce those that are best known.

One of the most famous is the big *Tropheus duboisi*, which can get up to 6 inches (15 cm) long. The first specimens of this species were collected in the northern part of the lake near the town of Pemba in 1959. In the meantime, three more variants have been discovered: *Tropheus duboisi* "Kigoma," *T. duboisi* "Karilani," and *T. duboisi* "Maswa," whose ranges extend along the east coast of the lake.

The most widespread variant in the hobby is *T. duboisi* "Maswa," whose body banding is a lot wider than that of its relatives and not pure white but whitish yellow.



Once one becomes addicted to keeping these cichlids, one aquarium isn't enough. Shown here is part of a Danish breeding facility for *Tropheus*.

Eponym of *T. brichardi* and one of the main people responsible for the Tanganyika fish boom is Pierre Brichard, whose company, Fishes of Burundi, still offers many treats for fans of Lake Tanganyika fishes. *Tropheus brichardi* is not recommended for beginners because its variants are almost all pretty aggressive. Their intraspecific aggression can occasionally anger even their owners. While almost all

Interestingly, among the offspring of parents whose body bands are only four or five scales wide there can be magnificent animals with bands up to seven scales wide.

In addition to *T. duboisi*, *T. sp.* "Black," especially the variants "Pemba" and "Kiriza" and *T. sp.* "Ikola," with the well-known "Emperor Moorii," are probably the most numerous morphs in the tanks of *Tropheus* lovers.

The "real" *T. moorii* was collected in 1895 by its namesake, the explorer and discoverer J.E.S. Moore, in the southern part of the lake, and is now known in the trade as "Blue Rainbow Moorii" or "Cape Chaitika." *T. sp.* "Red" is also very popular in the hobby. I am also much attracted to the variants from Moliro, Chipimbi, Ndole, and, in particular, Kachese.

other members of the genus have no external gender differences, *T. brichardi* females completely or partly retain their juvenile pattern of vertical body stripes.

Regarding intraspecific aggression, *T. sp.* "Mpimbwe" and *T. annectens* are no saints either. *Tropheus annectens*, perhaps better known under the synonym *T. polli*, the so-called "Banner Moorii," is the Goliath among *Tropheus* with a body length of up to 6.5 inches (16.5 cm).

When ranking the members of this genus according to their suitability for the *Tropheus* beginner, No. 1 would be *T. duboisi*, followed by *T. moorii*, *T. sp.* "Black," and *T. sp.* "Ikola." If you have already succumbed to the *Tropheus* bug and gained some experience, *T. annectens* and/or *T. brichardi* are worth a try.



After a period of acclimatization, the animals recognize their keeper and know where their food comes from. This is *Tropheus brichardi* "Ulwile."



Among the cave breeders of Lake Tanganyika, *Julidochromis* species have proven suitable as tankmates for *Tropheus*. Shown is *Julidochromis marlieri*.



The "Blue Rainbow Moorii" from Cape Chaitika, with the typical blue coloration in the dorsal fin, is the morph of *Tropheus moorii* on which the original species description was based.



Goby cichlids like this *Tanganicodus irsacae* "Moba" are also appropriate tankmates for *Tropheus*.



*Tropheus moorii* from Kasanga

### Territories and visual barriers

The *Tropheus* aquarium does not need to be 6.5 feet (2 m) long; 4 to 5 feet (1.3–1.5 m) is plenty. The tank should be 20 inches (50 cm) high and as deep as possible. Since I build my own tanks, I make them 28 inches (70 cm) deep, which leaves me more room for the layout.

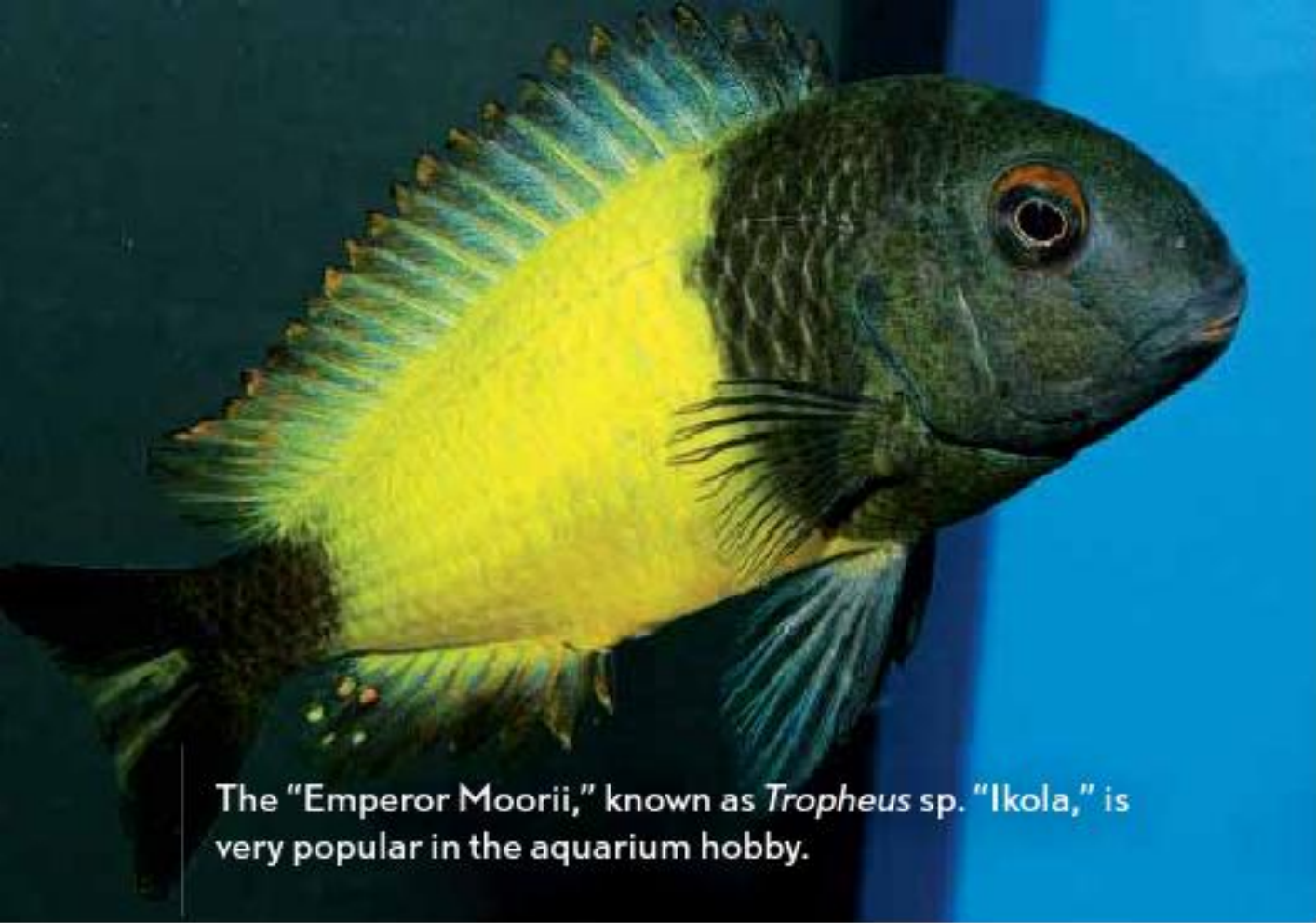
I am not a fan of the typical *Tropheus* setup—a holey rock left and a holey rock right, both covered with *Anubias*. Instead, I try to create lots of territories with large river stones and some tall slabs as visual barriers. I build different horizontal levels and leave about a third of the foreground as an open sand area completely free of decorations. Dominant males will occupy the territories and subordinate males and females will usually reside in the front, which is not interesting for the top dogs because there is nothing there worth defending. Another advantage of this sandy area is that the waste of the animals just stays on top, eventually getting stirred up and removed by the filter.

The tanks are filtered with

Hamburg Mattenfilters (Poret foam with airlift water returns). An extra power filter removes coarse waste, provides current, and oxygenates the water by disturbing the surface. Filtration is not the place to cut corners. Good water quality with pH values of 7.0–8.5, a carbonate hardness of 10–18°dKH, a total hardness of at least 10°dGH, and a temperature of 25°C (77°F) are all important prerequisites for the successful care of *Tropheus*.



*Tropheus brichardi* "Sanogo Green" is plainly colored.



The "Emperor Moorii," known as *Tropheus* sp. "Ikola," is very popular in the aquarium hobby.



The very attractive "Ilangi Moorii" is also seen on the cover of this issue of *AMAZONAS*.



*Tropheus moorii* from Mpulungu is another staple in the trade..



*Tropheus* sp. "Black" of the morph "Lunangwa South."

### Aufwuchs grazers

The magic formula for the *Tropheus* community is overstocking. Use approximately 4 gallons (15 L) of gross water volume per fish to counter aggression by distributing it among multiple individuals. This means about 35 fish for a 130-gallon (500-L) tank. Beginners should purchase tank-raised stock from a good breeder. This has

the distinct advantage that the animals grow up together and have the opportunity to get to know each other.

Most hobbyists don't want to keep only *Tropheus* in a tank; they want variety. For tankmates, I recommend the goby cichlids of the genera *Eretmodus*, *Tanganicodus*, and *Spathodus*, who have nutritional requirements similar to those of *Tropheus*. *Julidochromis* species also work well in



*Tropheus moorii* "Murago" is a prized aquarium fish.

a *Tropheus* tank.

*Lamprologus* species and their relatives are not recommended as tankmates due to their carnivorous diet. Because of their long ventral fins, featherfins (e.g., *Ophthalmotilapia* or *Cyathopharynx*) are out of the question. Sand cichlids, catfishes, or spiny eels have a negative impact on the well-being of our main actors because of their nocturnal activities.

As *aufwuchs* grazers, *Tropheus* in the wild exclusively feed on the algal turf and small organisms that cover their coastal habitat of boulders and rocks. Consequently, in captivity they are dependent on a high-fiber diet. Today the trade offers excellent foods with a high vegetable content, and moderate amounts of *Daphnia* or *Cyclops* won't hurt. For many years I have fed mainly a high-quality granulated food, and I am more than satisfied with it. In addition, I have had good results with a vegetable and shrimp mix recipe presented online at <http://www.reef2rainforest.com/2013/09/14/cooking-for-cichlids/>. The food servings should be eaten within three minutes.

Even when provided an appropriate diet and good water quality, some animals release transparent waste, engage in a shaking behavior, and refuse food. These are usually symptoms of stress due to changes in the tank, such as the addition of new animals or a lack of proper care. This weakens the animals' immune systems, and a subsequent rapid proliferation of intestinal parasites makes them susceptible to secondary bacterial infections. In an effort to prevent such problems, once a month for a few days I feed granulated food soaked in a homebrewed garlic potion.

### Mouthbrooders

*Tropheus* are maternal mouthbrooders. The females take up the eggs, which are fairly large compared to those of other



*Tropheus annectens*, also (incorrectly) known as *T. polli*.



*Tropheus* sp. "Mpimbwe" juveniles from Korongwe.



The colorful *Tropheus* sp. "Mpimbwe" from Msalaba.



Above: *Tropheus* should be kept in large groups. These are *Tropheus moorii* from Lufubu.

Below: Unusual yellow color morph of *Tropheus* sp. "Black" from Kiriza.



mouthbrooders, immediately after spawning. The male fertilizes the eggs in her mouth. On average, five to ten juveniles about 1 cm long are released after a gestation period of about four weeks. The female supports them for up to 10 days and takes them into her mouth if danger looms.

*Tropheus* are quite pricey, and some people are disappointed that their expensive investment only produces five babies—the monetary return they

expected doesn't materialize. The females always produce and take up more eggs than the number of babies that ultimately see the light of day—due to the cramped conditions in the mother's mouth, a few eggs invariably end up in the digestive system. So after a certain gestation period, some breeders catch the mouthbrooding females and remove the not yet fully developed larvae, then artificially raise them in incubators, or so-called "egg tumblers." It remains to be seen whether subsequent generations of animals produced this way have problems with natural mouthbrooding, but I reject this kind of "breeding" at the hobbyist level on principle. 🐟



*Tropheus* sp. "Red"  
from Chipimbi.



*Tropheus* sp.  
"Mpimbwe"  
showing the form  
known as "Golden  
Kushangaza."



The population of the *Tropheus* sp. "Mpimbwe Orange-Cheek" is rather dense, and large schools of foraging individuals are common.

## THE GENUS *Tropheus* AND ITS SPECIES



*article and images by Ad Konings* • The *Tropheus* species are comical-looking cichlids and are very popular among cichlid enthusiasts. The genus *Tropheus* is currently composed of eight species: *T. moorii*, *T. annectens*, *T. duboisi*, *T. brichardi*, *T. sp. "Black"*, *T. sp. "Ikola"*, *T. sp. "Red"*, and *T. sp. "Mpimbwe"*. Six species have been formally described in the genus; I have placed two of them, *Tropheus kasabae* and *T. polli*, in synonymy. Four species still await formal description, but are recognizable by various traits and restricted in their distribution by identifiable migration barriers. The taxonomy of this genus is confusing, not least because no one has seen every population or form in its natural habitat. As far as I know there is no rocky coast on the huge Lake Tanganyika that does not harbor a *Tropheus* species, and at least four of the species show great geographical variability, confusing the issue further.

Unfortunately, almost all *Tropheus* species are referred to as *T. moorii* in the aquarium hobby, which has befuddled quite a few hobbyists as well as scientists. *T. moorii*, the type species of the genus, has a restricted distribution in the southern part of the lake. Its northern counterpart, *T. sp. "Black"*, exhibits very similar behavior, but at a small rocky outcrop along the central coast of Tanzania both species can be found sympatrically, indicating that these are really two different species.

Below follows a description of the eight species that I recognize in the genus *Tropheus*. Many of the geographical variants have been regarded by some (e.g., Schupke, 2003) as valid species, but I disagree with many of these assumptions and will explain why.



### ***Tropheus moorii* Boulenger, 1898**

The holotype of *T. moorii* was collected by John E.S. Moore in 1895, with the type locality given as Kinyamkolo. For years it has been assumed that Kinyamkolo was the former name of what is now Mpulungu. I argued recently (Konings, 2012) that Kinyamkolo is a composite of two words: *Ki* and *Nyamkolo*. Niamkolo was a small village that is now Mpulungu. The suffix *Ki-* means “greater” and the whole word means Greater Nyamkolo. The word Kinyamkolo is used only by the missionaries in Niamkolo and by Moore; all subsequent explorers and collectors specifically refer to Niamkolo. Kinyamkolo is thus the name of the district, Southern Lake Tanganyika, in which the village of Niamkolo, where the actual mission was based, is located.

I further believe that the correct collection site of the holotype of *Tropheus moorii* is along the Ulungu Escarpment (Katoto to Cape Chaitika) rather than at Mpulungu or Kasakalawe. In the original description of *T. moorii*, Boulenger reports on its coloration as follows (derived from Moore’s sketches): “Dark brown; a large bluish-white blotch on each side; belly reddish brown; fins blackish.” Compare this description with any photo of an adult Blue Rainbow Moorii and you will notice that they match. In particular, the “bluish-white blotch on each side” is a character virtually restricted to the Blue Rainbow variant. It is thus likely that the types of *T. moorii* were collected near or at Cape Chaitika and that Moore regarded this place as being within the Kinyamkolo district.

In 1977, Nelissen described the subspecies *T. moorii kasabae* from aquarium specimens that were then (and still are) known as “Blue Rainbow Moorii” and were caught at Cape Chaitika and not at Kasaba Bay, as he was told by the importer of the fish. In 1986, Poll elevated *T. moorii* “Kasabae” to species rank as *T. kasabae*, but in light of the fact that the holotype of *T. moorii*

The southern populations of *Tropheus moorii* are characterized by a yellowish-colored blotch on the flank, and the variant at Kasakalawe, Zambia (above), shows the most intense orange hue.





Left: *Tropheus moorii* with an attractive but extremely rare color pattern seems to occur in various populations of this species. This male "Golden Red Rainbow" was photographed at Kambwimba (Tanzania).



Right: The so-called "Orange Moorii," *Tropheus* sp. "Black," at Pemba (Congo) has a very narrow distribution of less than one kilometer of shoreline.

actually comes from the same stretch of rocky shore as *T. kasabae*, there is little reason to dispute the idea that the two are conspecific. The name *T. kasabae* is thus a junior synonym of *T. moorii*.

**Diagnosis:** The main difference between *T. moorii* and the other members of the genus is the blue color of the membrane between the spine and the first ray of the pelvic fins. *T. moorii* shares this character, which manifests itself as a blue-tipped pelvic fin, only with *T. sp. "Mpimbwe."* It can be distinguished from the latter species by the very narrow or broken interorbital (between the eyes) stripes. The interorbital stripes in *T. sp. "Mpimbwe"* are always solid and wide. The interorbital

stripes are obscured or absent in adult males of both species, but those in male *T. sp. "Mpimbwe"* are very dark brown and easily distinguished from those of *T. moorii*.

### ***Tropheus annectens* Boulenger, 1900**

The types of *T. annectens* were collected by Captain Célestin Hecq, who served with the Belgian Forces stationed in the Congo fighting the slave trade in the last decade of the nineteenth century. The type locality for all of Hecq's Tanganyikan cichlids is given as Albertville, which is usually interpreted as Kalemie, Congo, but this is incorrect. Captain Hecq collected *T. annectens* while he was commander of the fort at Mtoa, which was called



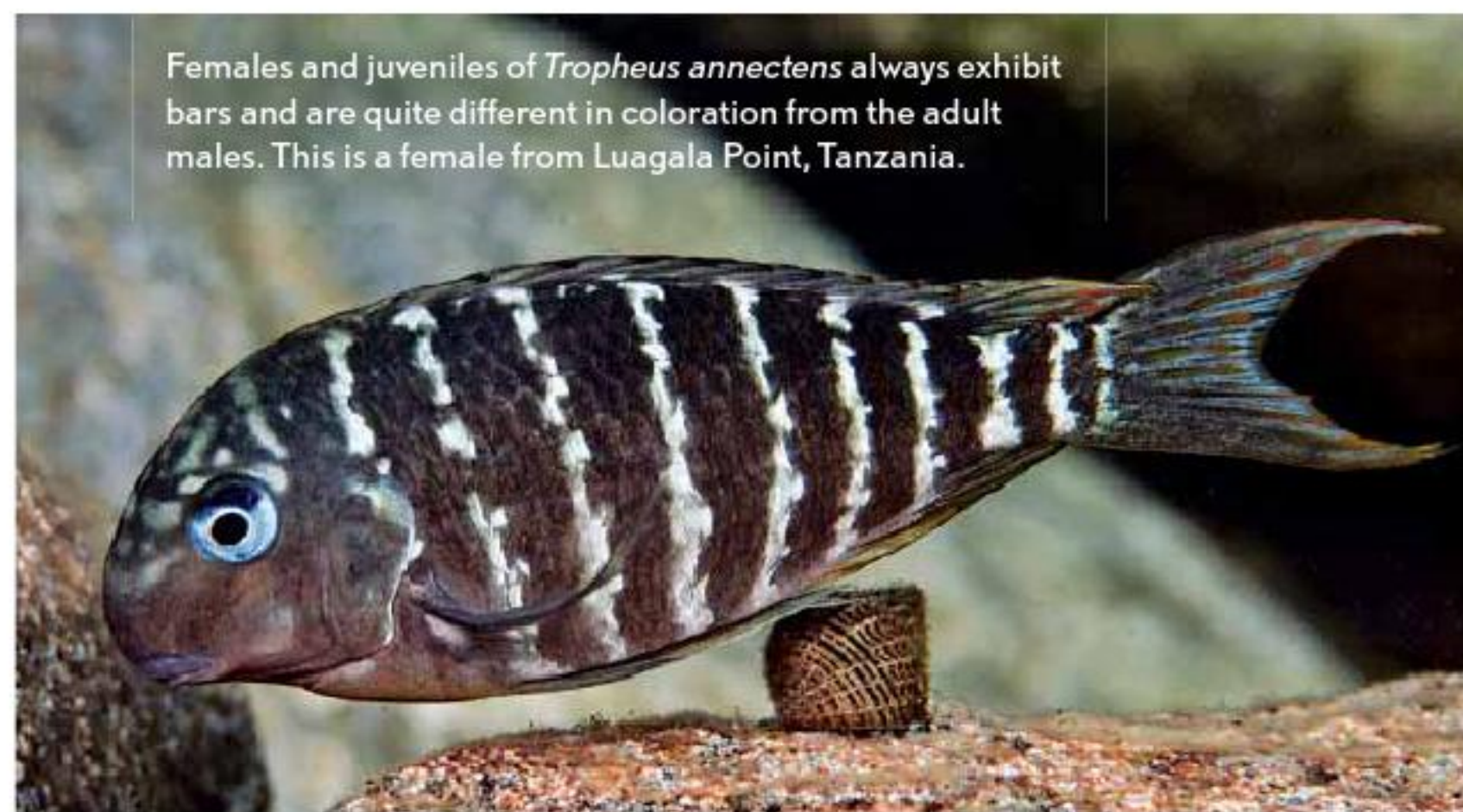
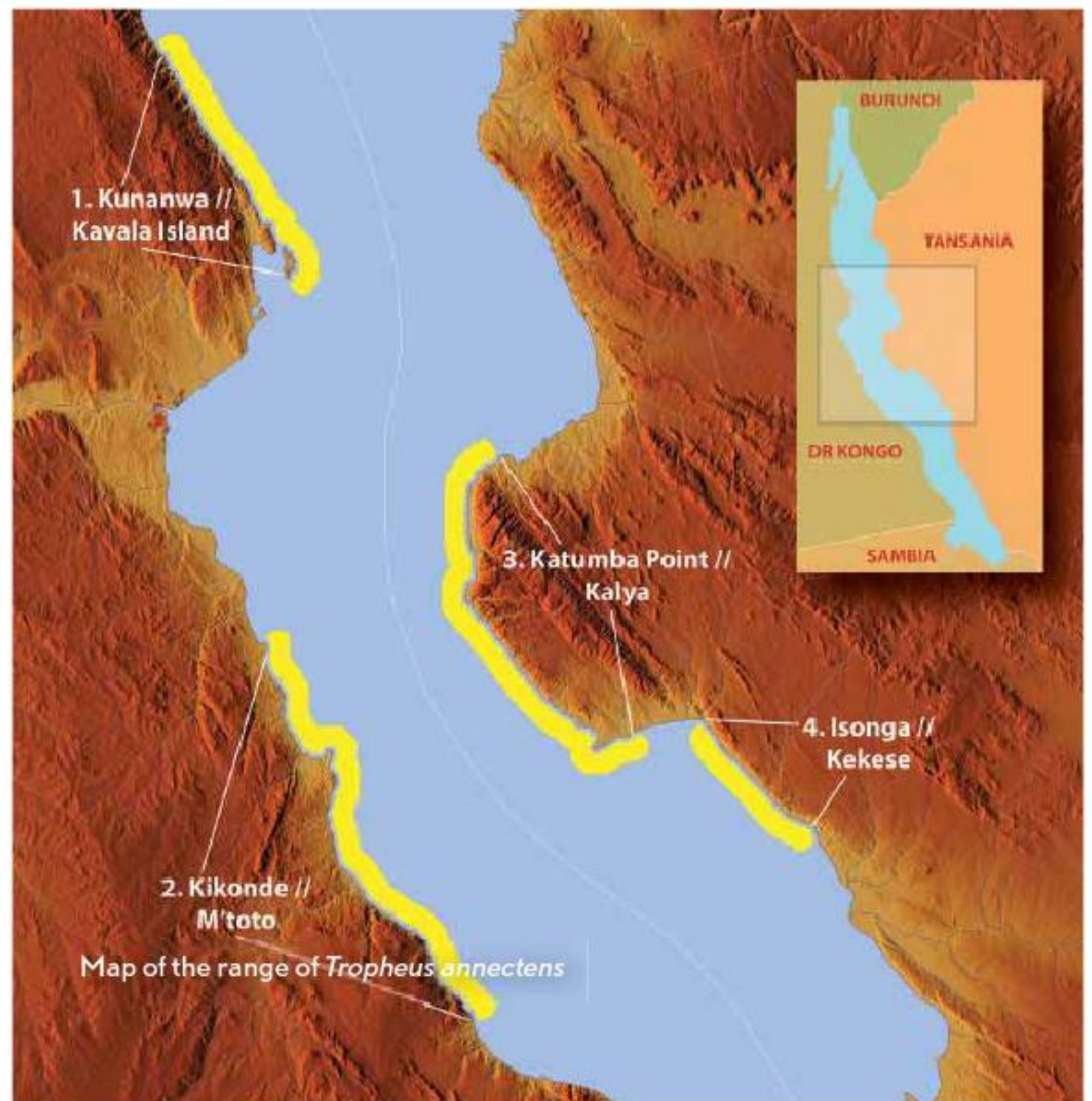
Fully adult males of *Tropheus annectens* lose the barring pattern and become bluish to brownish in color. Note classic *Tropheus* mouth, adapted for grazing.

Albertville for 20 years, from 1894 to 1914. The shoreline at Mtoa is just opposite the Kavala Islands, and *T. annectens* has been exported from there under the name *Tropheus* “Kongole” (Konings, 2013).

Like most other *Tropheus* species, *T. annectens* prefers the upper rocky habitat and is rarely found deeper than 25 feet (7 m). Even though there are large stretches of sandy shore (from which *Tropheus* is absent) in the eastern distribution of *T. annectens*, the three to four rather isolated populations do not show any significant geographical variation. And, remarkably, the population on the opposite Congolese coast at M'toto is not much different either. I have not yet been able to observe the population at the Kavala Islands near Mtoa (the “Kongole”), but aquarium specimens appear nearly indistinguishable from the other populations.

The eastern populations in Tanzania have been described by Axelrod (1977) as *T. polli*, but he had not physically compared his “new” species with the types of *T. annectens*. Notwithstanding Axelrod’s inadequate examination, the name *T. polli* has, unfortunately, found common usage, even among scientists. It is still amazing that, 20 years after I explained this obvious synonymy (Konings, 1992), most authors insist on using the name *T. polli*, although no alleged distinction between the two forms has ever been published. In fact, scientists who use the name *T. polli* for the eastern populations of *T. annectens* provide the most convincing evidence that we should regard all these populations (east and west) as belonging to *T. annectens*. Sturmbauer et al. (2005) found that the Kongole *Tropheus* of the Kavala Islands has such a genetically close relationship with the eastern population from the Kungwe Mountains shore in Tanzania that they could be regarded as a single population!

The most plausible explanation of why the *T. annectens* populations are so far apart at present is found in the rise and fall of the lake level. From molecular genetic analyses, we know that *T. annectens* split from the *Tropheus* ancestor about 1–1.4 million years ago (Koblmüller et al., 2010). From lake-bottom core analyses, we know that lake levels have dropped dramatically on several occasions in the last 140,000 years. At a very low lake level about 100,000 years ago, *T. annectens* was present and restricted to the central basin of the lake. During that low water level, the northern lake basin was separated from the central basin by a rocky ridge that extended from Luagala Point in Tanzania to the Kavala Islands



Females and juveniles of *Tropheus annectens* always exhibit bars and are quite different in coloration from the adult males. This is a female from Luagala Point, Tanzania.

in the Congo and is therefore referred to as the Kavala Island Ridge. It is easy to imagine that, as the lake level rose, *T. annectens* moved up along this ridge in order to remain in the upper 10 feet (3 m) of the rocky habitat. At present, the Kavala Island Ridge is underwater and the only suitable habitat left for *T. annectens* is at either end of the ridge—the Kavala Islands and Luagala Point.

**Diagnosis:** The members of this species can be readily identified because they have only four spines in the anal fin; all other *Tropheus* species have five to seven anal spines. Another distinguishing characteristic is that adult males have a color pattern noticeably different from that of females, and, together with *T. brichardi* and *T. sp.* “Mpimbwe,” form a group within the *Tropheus* genus that shows sexual dichromatism.



The polka-dotted *Tropheus duboisi* juveniles of all populations look identical. These were photographed at Pemba (Democratic Republic of Congo).

### *Tropheus duboisi* Marlier, 1959

All *Tropheus* species resemble each other in shape and size, and since Poll (1946) had synonymized *T. annectens* with *T. moorii*, all subsequent authors referred to any *Tropheus* species as *T. moorii* until 1959. It was not until then that Marlier found two different species at the same locality where *T. duboisi* was described. Apart from the obvious difference in coloration compared to other *Tropheus* species, the mouth of *T. duboisi* is more terminal and it feeds with its body at a greater angle to the substrate than other *Tropheus* species, which browse in an almost horizontal position, probably giving them more stability in the sometimes turbulent upper regions of the rocky habitat. This could be one reason *T. duboisi* is often found somewhat deeper than *T. brichardi* or *T. sp. "Black,"* with which it shares the habitat. Along the Tanzanian shore, *T. duboisi* is found sympatrically at

all known localities with *T. brichardi*, and the latter is found mainly in the upper 10 feet (3 m) of the rocky habitat. At Luagala Point *T. duboisi* shares the habitat with three(!) other members of the genus—*T. brichardi*, *T. annectens*, and *T. sp. "Black."* Here *T. duboisi* dwells at depths greater than 33 feet (10 m), yielding the shallows to *T. sp. "Black"* and *T. annectens*.

*T. duboisi* occurs at several localities in the northern half of the lake, but nowhere is it the only representative of the genus. It is the oldest species of the genus alive today and likely had a much wider, or at least a continuous, distribution in earlier days. The decline in its distribution was probably caused by competition from species with similar requirements, including other *Tropheus* species but also *Simochromis* and, perhaps, *Petrochromis* species. Koblmüller et al. (2010) estimated that *T. duboisi* diverged from all other *Tropheus* species about 2 million years ago and that the remaining *Tropheus* species started to diverge around 1.4 million years ago.

**Diagnosis:** In addition to its slightly different mouth structure, *T. duboisi* differs in its color pattern, which consists of a blue head and a dark blue to black body in adults, with a white to yellowish vertical band on the flank below the spinous part of the dorsal. Juveniles have the most characteristic coloration, consisting of a black body with vertical columns of white to light blue spots on the flanks and more irregularly on the rest of the body. The anal fin has five or, rarely, six spines.

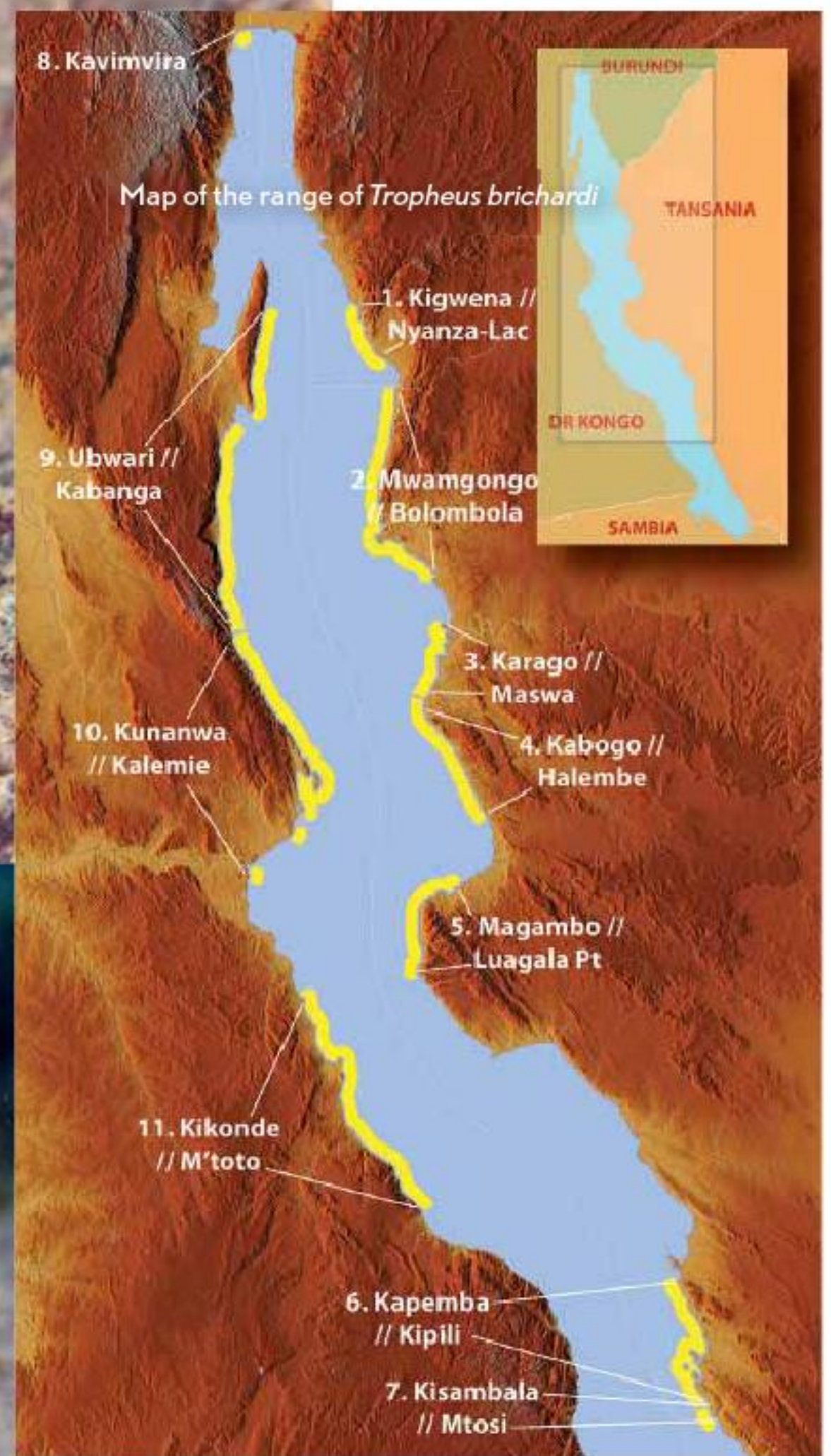


Although *Tropheus duboisi* has been heavily overfished at Karilani Island, I was pleased to discover that another population occurs further south at Luagala Point, Tanzania.



Above: Juveniles of the southernmost variants of *Tropheus brichardi* have a very attractive yellow-to-orange ground color. These are from Mtosi, Tanzania.

Below: The variant of *Tropheus brichardi* found just south of the Malagarasi River delta (Maswa) is characterized by a rather large, irregular yellow blotch below the origin of the dorsal fin.



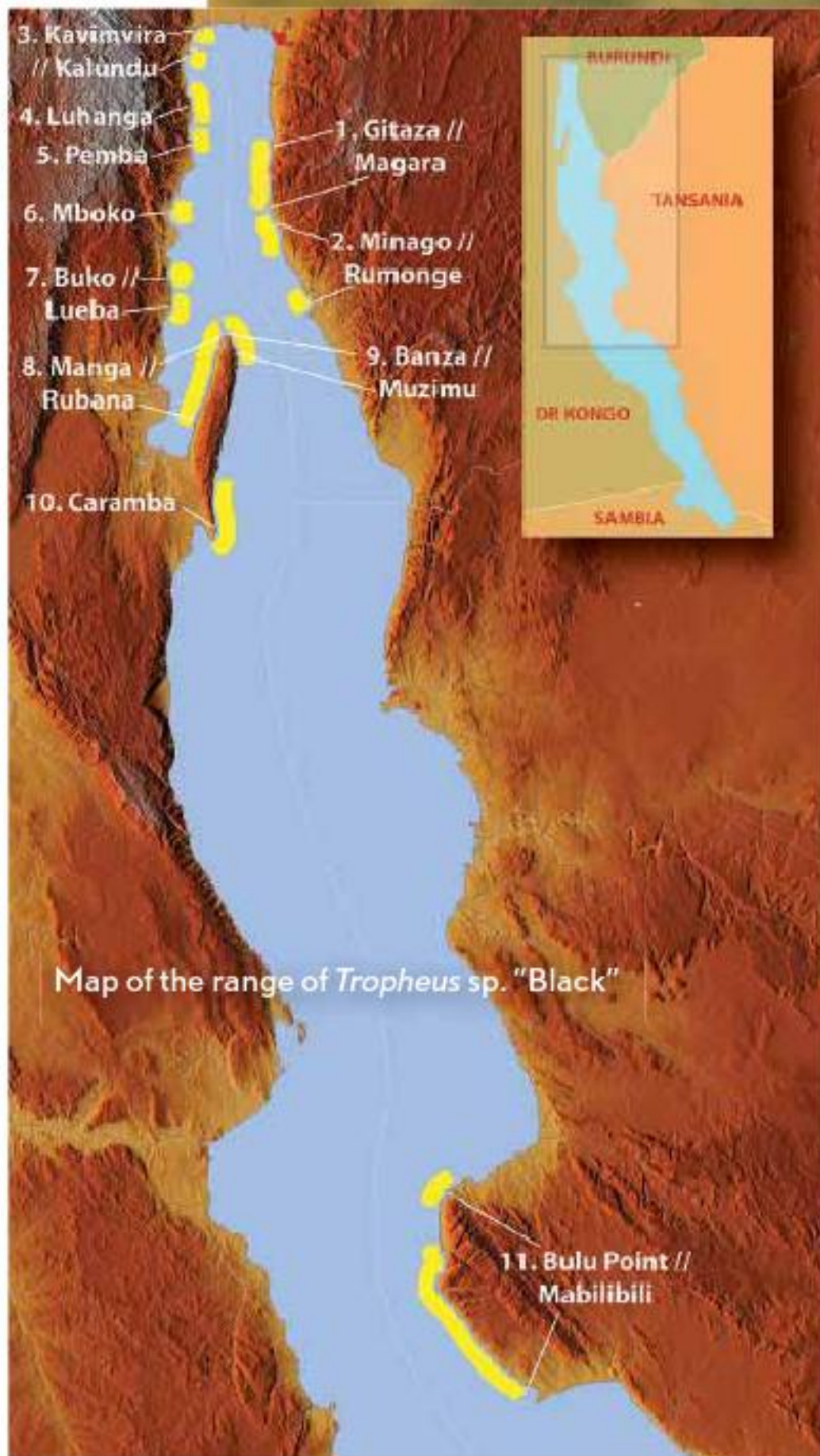
is separated from the nearest *T. brichardi* (at Luagala Point) by about 110 miles (175 km) of shoreline, formed a group and split off from the other populations earlier than the single specimen from across the lake

that they included in their analysis.

*T. brichardi* also shares the habitat with other members of the genus besides *T. annectens* and *T. duboisi*. Although Schupke (2003) and Tawil (2012) reported that *T. brichardi* shares the habitat with other *T. brichardi*-like species at Nyanza-Lac, I have not seen this, and neither had Brichard (1989), who found *T. brichardi* sympatric with *T. sp.* "Black" (referred to as *T. moorii*) at Kavimvira in the northernmost part of the lake and further noted that *T. brichardi* at Kavimvira was highly outnumbered by *T. sp.* "Black." This suggests that *T. sp.* "Black" is the better-adapted species of the two. This is also evident at Luagala Point, where I found that *T. sp.* "Black" heavily outnumbered *T. brichardi*, which was also "banned" to deeper and less favorable regions of the rocky habitat. At Mtosi (south of Kipili) *T. brichardi* shares the habitat with *T. moorii* (Konings, 1995), but occupies the

### ***Tropheus brichardi* Nelissen & Thys van den Audenaerde, 1975**

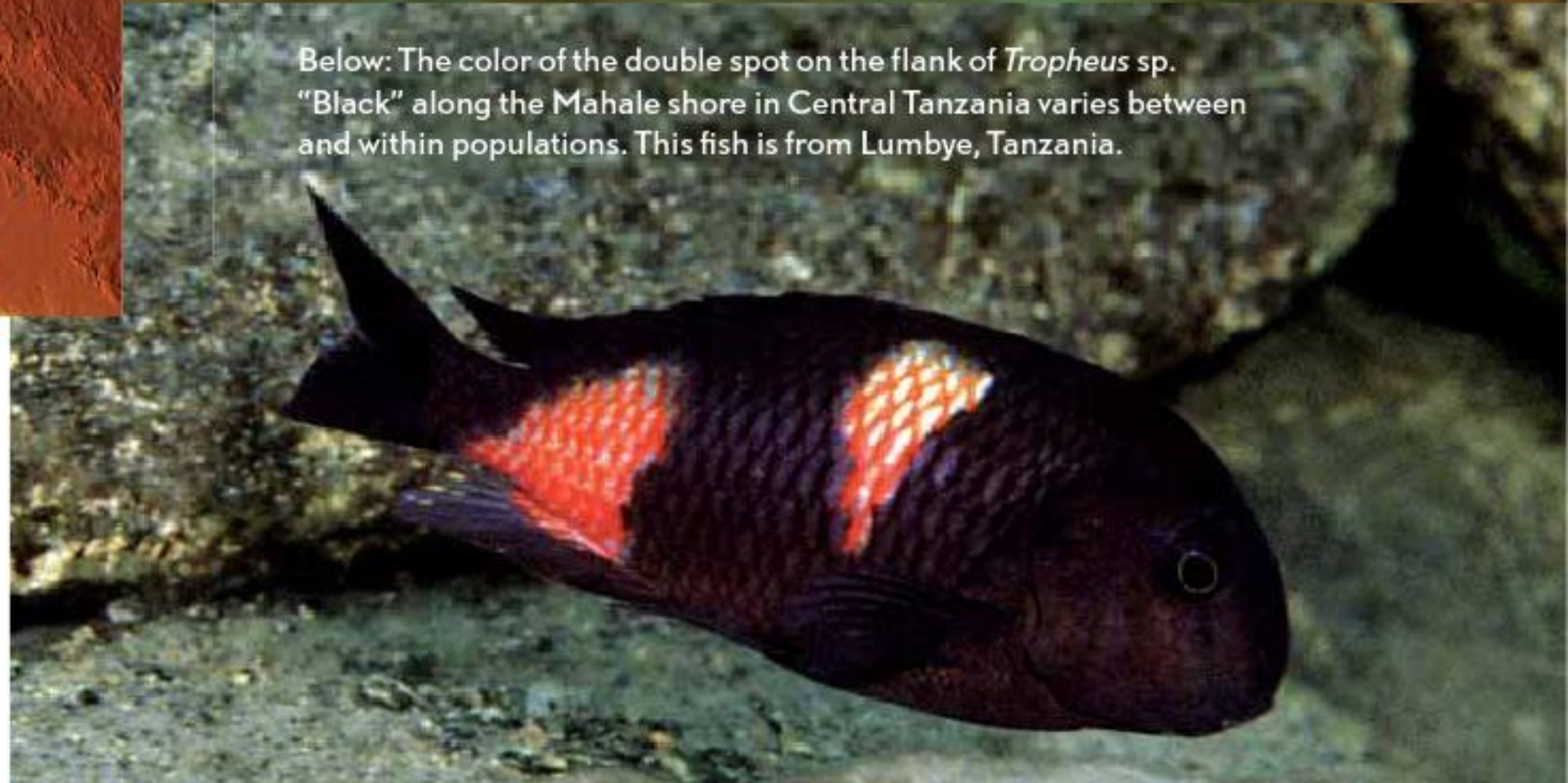
*Tropheus brichardi* was described from specimens collected at Nyanza Lac in Burundi by Pierre Brichard. This population is known as the "Schoko Moorii." Through nuclear DNA analysis of specimens from Nyanza Lac, Bulombora, Halembe, the Kipili area, and Kabimba, Egger et al. (2007) and Koblmüller et al. (2010) found that *T. brichardi* diverged from the other *Tropheus* species as the first branch after *T. duboisi*. Egger et al. found four well-supported clades (genetic groups) among the *Tropheus* specimens from about 35 different populations, and all their *T. brichardi* specimens grouped together in their first clade (AFLP1). This strongly supports the argument that *T. brichardi* is a valid species that can be distinguished on the basis of its nuclear genes. Egger et al. also found that *T. brichardi* from the Kipili area, a population that



Map of the range of *Tropheus* sp. "Black"



Above: The *Tropheus* sp. "Black" along the southern half of the Ubwari Peninsula (Caramba) shares the habitat with the so-called Green Moorii variant of *Tropheus brichardi*.



Below: The color of the double spot on the flank of *Tropheus* sp. "Black" along the Mahale shore in Central Tanzania varies between and within populations. This fish is from Lumbye, Tanzania.

less-preferred part of the rocky habitat—regions deeper than 33 feet (10 m)—whereas it is found in the upper regions at places further north where *T. moorii* is absent. Near Cape Caramba, at the southern point of the Ubwari Peninsula, *T. brichardi* shares the rocky habitat with *T. sp. "Black"* but is not relegated to the deeper parts of the habitat; in fact, the opposite may be the case. *T. brichardi* (the "Green Moorii") often occurs in water shallower than that preferred by the more common *T. sp. "Black,"* but both species are frequently seen side by side, which is not true south of Kipili or at Luagala Point.

It appears that *T. brichardi* tolerates a higher level of sedimentation on the substrate. Therefore, it is found in silted areas as well as in deeper rocky regions. This may also have facilitated its dispersal along both the eastern and western shores of the lake.

**Diagnosis:** The main characteristic of *T. brichardi* is the color pattern of juveniles and non-mouthbrooding females, which consists of distinct and regular vertical bars. The light-colored bars are almost always at least two scales wide, while those in juveniles of *T. moorii* and *T. sp. "Red"* are almost always one scale wide or incomplete. The species that most resembles *T. brichardi* is *T. sp.*

"Mpimbwe," from which it can be distinguished by the color of the leading edge of the pelvic fins; those of *T. sp. "Mpimbwe"* are blue, and in *T. brichardi* they are yellow. Another difference is that *T. brichardi* usually has six spines in the anal fin and *T. annectens* always has four.

### *Tropheus* sp. "Black"

In 1991, near Sibwesa, Horst Dieckhoff discovered a new population of *T. moorii* that shared the rocky habitat with two other *Tropheus* species (Konings, 1991): *T. annectens* and the so-called "Kirschfleck Moorii." From that point on, it was clear that the "Black Moorii" from the northern part of the lake could not be conspecific with *T. moorii* because they were found side by side near Sibwesa. From then on, I have referred to the black-tailed *Tropheus* from the northern half of the lake as *T. sp. "Black"* (Konings, 1991). By analyzing nuclear DNA

(AFLP), Egger et al. (2007) confirmed that the northern populations of *T. sp. "Black"* (Pemba, Mboko, Kiriza, and Rutunga populations) share the same clade (a group evolved from a common ancestor) with those along the Mahale Mountain range (Bulu, Siyeswe, Mabilibili, and Ikola). In my opinion, the population at Ikola represents a separate, more recent species (see *T. sp. "Ikola"*). Egger et al. also found that, understandably, the northern and southern populations formed two separate groups within the *T. sp. "Black"* clade.

**Diagnosis:** All geographical populations of *T. sp. "Black"* have a black background color on the body and fins. In stressed individuals, the black color disappears on most of the body and fins but remains on the posterior part, including the caudal fin, the caudal peduncle, and often a section of the flank, following an invisible line from the origin of the rayed portion of the dorsal fin to the origin of the anal fin. Tawil (2012) offers a more important distinction between *T. sp. "Black"* (and *T. sp. "Ikola"*) and almost all the other members of *Tropheus*: the permanent loss of the juvenile bar pattern. While adult females of *T. moorii*, *T. annectens*, *T. brichardi*, *T. sp. "Red,"* and *T. sp. "Mpimbwe"* exhibit multiple bars of the juvenile color pattern, those of *T. sp. "Black,"* *T. sp. "Ikola,"* and *T. duboisi* do not. During maturation, the thin, light-colored bars in juveniles disappear except for one to four bars below the spinous part of the dorsal fin, which broaden and merge to create a distinct bar on the flank of the adult individual. There is no morphological difference between *T. sp. "Black"* and *T. sp. "Ikola,"* but adults of the latter species have a wide yellow bar (wider than 11 scales in most individuals), while the bar in *T. sp. "Black"* (from Pemba) is at most seven scales wide (counted at the upper lateral line).

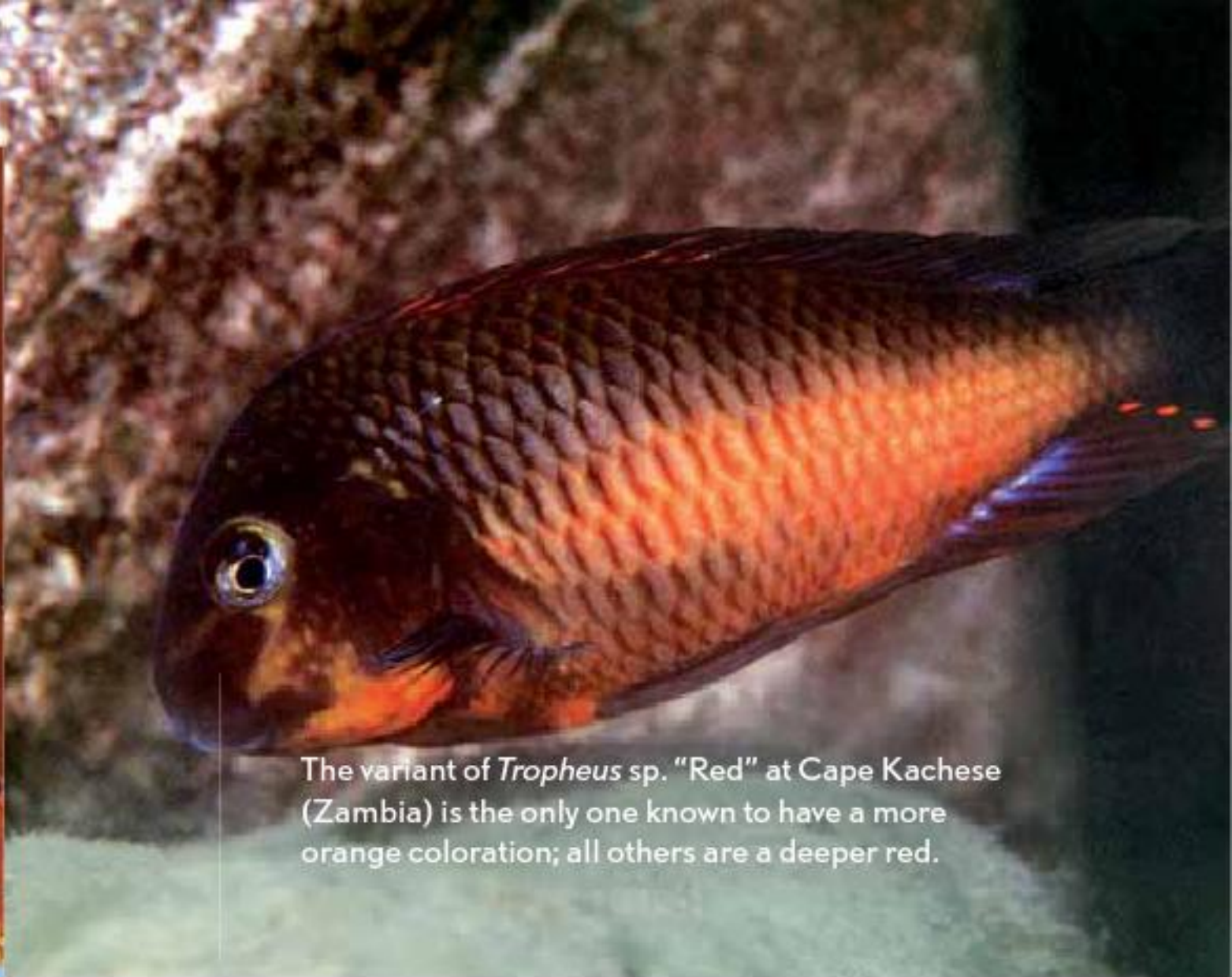
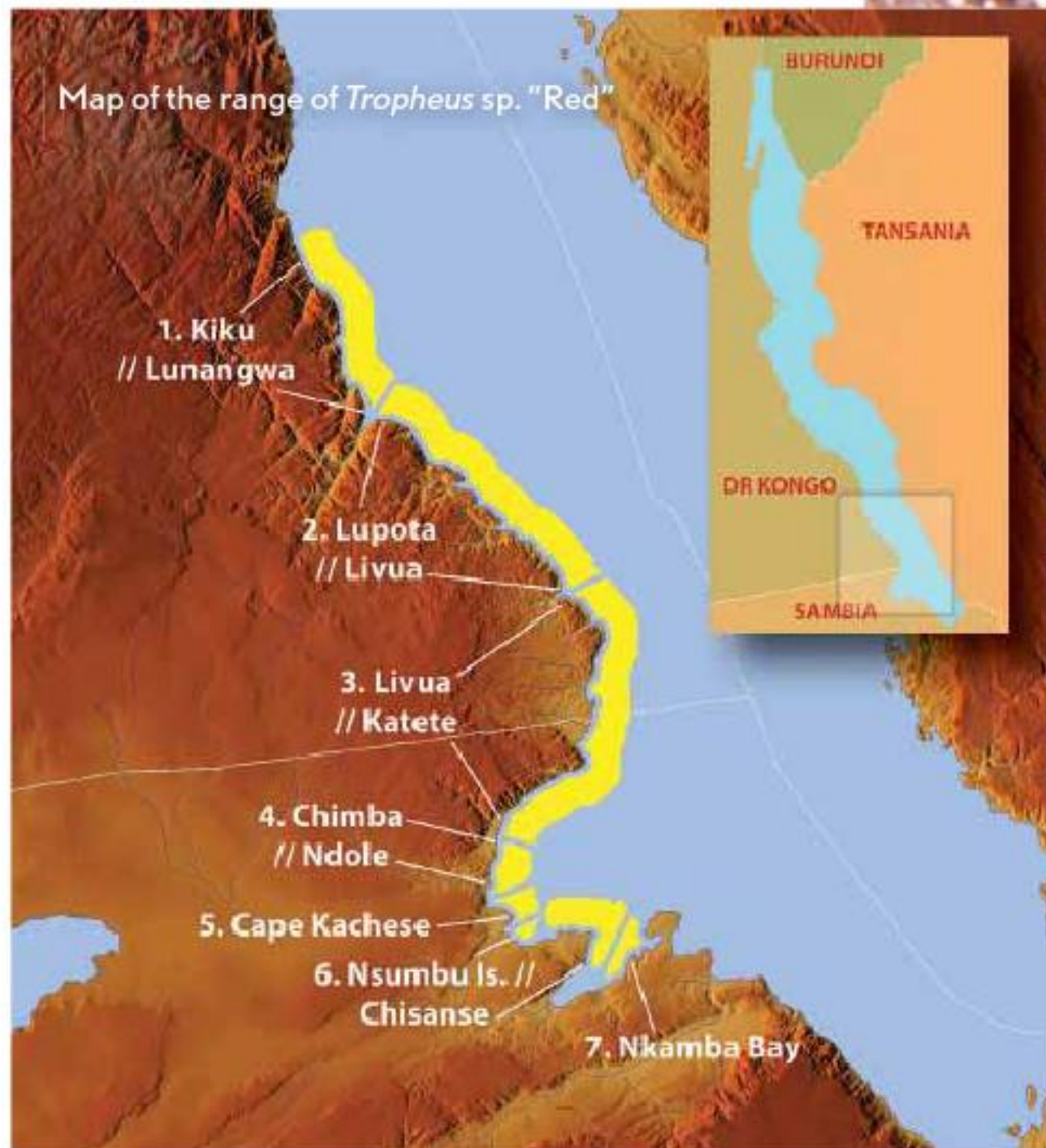


### *Tropheus sp. "Ikola"*

This species is better known as the "Kaiser Moorii" and is very popular among aquarists. The Kaiser Moorii is restricted to the rocky shores between Ikola and Isonga. The shore at Ikola is pure sand and the rocky coast starts about 12 miles (20 km) north of the village. At the northern end of the rocky area, near Isonga, the shore projects into the lake at an almost 90-degree angle. The entire shoreline as far as Sibwesa, about 11 miles (18 km), is sandy. *T. sp. "Ikola"* seems to live in a single, continuous population, and geographical variants are not known. Without a doubt, *T. sp. "Ikola"* is derived from *T. sp. "Black,"* and some authors consider them to be conspecific, but in my opinion *T. sp. "Ikola"* should be regarded as a good species, as it evolved recently during the last major rise in lake level, about 14,000–20,000



The Kaiser Moorii, *Tropheus sp. "Ikola,"* shares the habitat with *T. annectens* throughout its distribution.



The variant of *Tropheus* sp. "Red" at Cape Kachese (Zambia) is the only one known to have a more orange coloration; all others are a deeper red.

years ago, when their present habitat became available as living quarters. If it were conspecific with *T. sp. "Black,"* I would have expected the "Kirschfleck" variant of that species to be present along the Ikola shore. It appears that the populations of *T. sp. "Black"* are relics from a much wider distribution in the northern basin of the lake (Egger et al., 2007). However, this remains a matter of opinion because no measurable differences are likely to be found between the two forms.

**Diagnosis:** Since *T. sp. "Ikola"* is closely related to *T.*

*sp. "Black,"* it has the same diagnostic characters as that species—the black background color on the body and fins and the disappearing bars of the juvenile color pattern (see above). Stressed young individuals of *T. sp. "Ikola"* may exhibit a sea-green to olive-greenish hue on the head and anterior part of the body, and can thus sometimes be distinguished from similar-sized individuals of *T. sp. "Black,"* which usually have a more yellowish or orangey hue.

### ***Tropheus* sp. "Red"**

Since 1993, I have regarded the red-black variants of *Tropheus* in the southwestern part of the lake as a separate species because *T. sp. "Red"* had been found sympatric with *T. moorii*. A few kilometers north of the Lunangwa River, at Kiku (Congo), a red-colored variant of *Tropheus* is found in the upper rocky habitat. This population dif-



The bright red blotches on the cheek and posterior flank of *Tropheus* sp. "Red" at Chimba (Zambia) only "lighten up" when the male is in an aggressive mood.

fers noticeably from the one at Kapampa (about 12 miles/20 km to the north), but no clear boundary between these two populations can be established. Christian Houllier (pers. comm.) also found the “Kapampa Moorii” at Kiku, where it lives sympatrically with the red variant, and Brichard (1989) reported the sympatry of a variant of the “Red Moorii” (his Nsumbu-Nkamba line) and a variant of *T. moorii* (his Kabeyeye line) in Nkamba Bay. These findings indicate that the “Red Moorii” is a true species, distinct from *T. moorii*.

Among aquarists, it is generally accepted that *T. sp. “Red”* is a separate species, even though it occurs within the same general distribution as *T. moorii*. Recently

a lot more evidence that these are two different species has been published. Egger et al. (2007) found through DNA analysis that *T. sp. “Red”* (from Livua, Moliro, Chipimbi, Chisiki, Ndole, Kachese, and Chisanze) was grouped together with *T. moorii* in the same major clade, but within this clade it formed an entity completely separate from the “true” *T. moorii* (from 21 different localities in the southern section of the lake). Breeding segregation studies in the aquarium and in the lake have also provided evidence. In one such study, Egger et al. (2008) found that *T. sp. “Red”* from Moliro and *T. moorii* from Nakaku (Ulungu Escarpment) exhibited assortative mate preferences: when females had a choice between their proper mate

and a male of the other species, they chose their proper mate in 13 out of 14 trials.

The so-called “Ilangi Moorii” is found sympatrically in Kasaba Bay with the Chilanga variant of *T. sp. “Red”* (Toby Veall, pers. comm.). It is sometimes regarded as a geographical variant of *T. moorii* because of its yellow body. However, in DNA analyses it either groups with *T. sp. “Red”* (Salzburger et al., 2006) or forms a distinct entity between *T. sp. “Red”* and *T. moorii* from the southern populations (Egger et al., 2007). All these findings indicate that the “Ilangi” is not a “pure” species and may have originated from a natural hybrid between the Chilanga variant of *T. sp. “Red”* and the Nangu variant of *T. moorii*. Before the variant was completely fished out of the lake it had only a very small area of overlap—several hundred meters of shoreline—with *T. sp. “Red”* (Toby Veall, pers. comm.). Unfortunately, it also shared



Males of *Tropheus sp. “Mpimbwe”* at Kasombo (Tanzania) lack a colored blotch on their cheeks, but females are indistinguishable from those of the other populations.

its habitat with about 200 large crocodiles, which made *in situ* observation of this desirable variant less attractive. Schupke (2003) reports two different types of fry from a pair of “Ilangi,” which may indicate that this variant is not an established line and that each individual may be the result of a cross. Time will tell; if the constant pursuit of this variant for the ornamental fish trade can be halted for a few years, we may see it again.

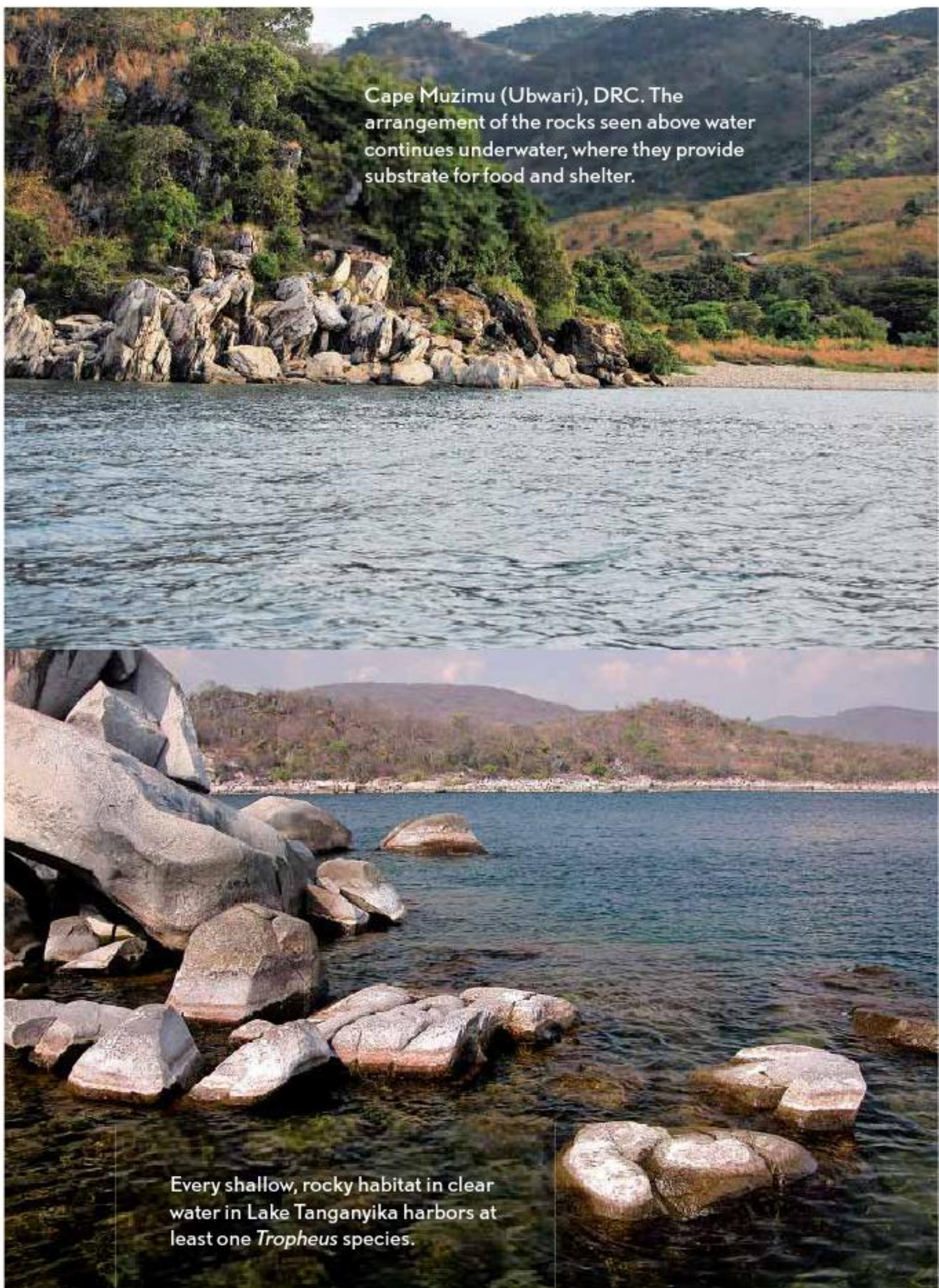
**Diagnosis:** The characteristics of *T. sp. “Red”* are a dark body with a Bordeaux-red hue, two chevron-like stripes between the eyes, and sometimes a bright-colored blotch on the lower cheek, particularly in males. Other differences between *T. moorii* and *T. sp. “Red”* are the tiny spots found on the head of *T. moorii* and not *T. sp. “Red”* and the blue color of the tip of the first ray in the pelvic fin, a characteristic found in all populations of *T. moorii* including those near Sibwesa and along the Congolese shore. The anterior edge of the pelvic fin in *T. sp. “Red”* is dark brown or reddish, not blue. Under water, *T. sp. “Red”* is readily identified because most individuals show a dark, almost black coloration. None of the populations known have light-colored flanks, the most obvious characteristic of *T. moorii*.

### ***Tropheus sp. “Mpimbwe”***

*Tropheus sp. “Mpimbwe”* has previously been referred to as a variant of *T. brichardi*, but because it is found in an area of the lake that is relatively new, and because its juveniles differ dramatically in coloration from neighboring *Tropheus* populations, I started to treat it as a separate species (Konings 1998). It occurs at Cape Mpimbwe (also known as Msalaba) and between Karema and Kabwe, and does not overlap with *T. brichardi*. I found *T. brichardi* (the “Kipili Moorii” variant) at Cape Korongwe, near the village of Kapemba, and Karlsson (1998) discovered the yellow-cheeked form in Korongwe Bay. Thus, the two species *T. brichardi* and *T. sp. “Mpimbwe”* appear to be separated by a sandy shore (the beach at Korongwe village) approximately 2 miles (3 km) long. Juvenile *T. sp. “Mpimbwe”* are not orange or bright yellow like those of *T. brichardi* at Kapemba or Kipili; they have an attractive pattern of dark brown bars on a white or pale yellow background. This pattern closely resembles that of *T. annectens* juveniles; however, *T. annectens* is characterized by four spines in the anal

fin, whereas all other *Tropheus* species, including *T. sp. “Mpimbwe,”* have five to seven.

In DNA analyses, *T. sp. “Mpimbwe”* often groups with or close to *T. moorii*. Egger et al. (2007) found *T. sp. “Mpimbwe”* as a sister group to all other lineages in their AFLP4 clade, which includes *T. moorii* (southern and central lake populations) and *T. sp. “Red.”* Using mitochondrial gene markers, their position is less clear but still close to a *T. moorii* population. Koblmüller et al. (2010), using nuclear DNA markers but fewer *Tropheus* species, also found *T. sp. “Mpimbwe”* as a sister group to *T. annectens* from Kekese (referred to as *T. polli*). Another character that *T. sp. “Mpimbwe”* has in common with *T. moorii* is the blue-tipped pelvic fin. When we combine



Cape Muzimu (Ubwari), DRC. The arrangement of the rocks seen above water continues underwater, where they provide substrate for food and shelter.

Every shallow, rocky habitat in clear water in Lake Tanganyika harbors at least one *Tropheus* species.


## TROPHEUS HABITATS

The *Tropheus* species are found in the shallow waters of Lake Tanganyika and occupy a very restricted range of rocky habitat along the lake's shores. The rocks in their preferred habitat are piled on top of each other, forming a complicated network of caves and crevices. Except for *T. duboisi*, all *Tropheus* species occur in the upper 65 feet (20 m) of the rocky habitat. They sometimes occur in intermediate habitats but are never found over pure sandy bottoms. Subadults of less than 2 inches (5 cm) in total length are most often found in water rarely deeper than 7 feet (2 m), while very small juveniles a few months old live among the pebbles and stones of the extremely shallow water where they were released by their mothers.

The depth distribution of *T. duboisi* ranges between 15 and 100 feet (5–30 m), with the highest density at about 25 feet (8 m); only small juveniles are sometimes seen in shallower water.


The habitat of *Tropheus* species is normally populated by large numbers of other cichlids. Food is available in abundance, so competition is mainly for territories. The result is that every square foot has been claimed by one cichlid or another. The size of the rocks can vary from football-size to huge boulders. The sediment-free areas are usually located on rather steep-sloping shores, where the sediment accumulates at the base of the rocks or in deeper layers. The rocks are invariably covered with a layer of *aufwuchs*, which contains more green algae in

the shallow areas. The *aufwuchs* consists of a variety of algae: the tough strands of some filamentous algae are attached to the rocks and form a matrix on which other algae, the so-called "loose *aufwuchs*," grow. This biocover also includes small crustaceans and other microorganisms. *Tropheus* species are mainly interested in the filamentous algae and prefer sites that are "pre-cleaned" by other species, mostly *Petrochromis* species, with whom they often share territorial space. In Lake Tanganyika, the high mineral content of the water, combined with a high pH of around 9, results in a permanent coating of crystalline salts (e.g. calcium) on every object in the water. Where rocks are not exposed to algae-grazers, these minerals can build up into layers an inch or so thick and create an irregular pattern of cracks and pockets.



Habitat of *Tropheus* sp. "Ikola" at Kalugunga (Tanzania). Each rock in this shallow section is covered with a thin film of algae, which are grazed upon by Kaiser Moorii.

MARTIN GEERTS



In some places *Tropheus* species school together in large, foraging bands and feed in territories that would be inaccessible to the individual fish.

the DNA analyses with the morphological characteristics, we cannot escape the notion that *T. sp.* "Mpimbwe" may have originated as a hybrid of *T. moorii* and *T. annectens*. We know that *T. moorii* likely had a much wider distribution in the southern basin during a time of low water level, and *T. annectens* is still found as a neighboring population north of Karema.

At Kalila and Kasombo, north of Kabwe and south of Karema, I found males of a *T. sp.* "Mpimbwe" form, which lack the brightly colored blotch on the lower cheek. However, because females and juveniles of this morph closely resemble those of *T. sp.* "Mpimbwe," I refer to that morph as a representative of *T. sp.* "Mpimbwe." Nevertheless, in Baric

et al. (2003) a representative of this population shared a mitochondrial haplotype (a set of gene versions) with *T. sp.* “Ikola” (as well as with *T. moorii*), although *T. sp.* “Mpimbwe” from Cape Mpimbwe did not. Analogous to my recognition of *T. sp.* “Ikola” as a species separate from *T. sp.* “Black,” I could also argue for species status for the Kasombo morph of *T. sp.* “Mpimbwe,” but due to its resemblance to the morph at Cape Mpimbwe and the lack of nuclear DNA data on this morph and the one at the Cape, I regard it as a geographical variant of *T. sp.* “Mpimbwe.”

**Diagnosis:** Males of *T. sp.* “Mpimbwe” are recognized by a dark, reddish-brown color and a large size. The tail in this species is truncated or slightly emarginated, but forked in *T. annectens*. Males differ from those of the darker morphs of *T. sp.* “Red” by the absence of light-colored chevron-like stripes on the snout and by a pelvic fin with a bluish tip, while the pelvic in *T. sp.* “Red” is tipped brown or black. Females of *T. sp.* “Mpimbwe” resemble those of *T. annectens* and *T. brichardi* but are distinguished from the former by the shape of the tail (see above) and from those of the latter by the distinct blue tip and anterior margin of the pelvic fin, which is brown in *T. brichardi*. Also, the barring pattern of *T. sp.* “Mpimbwe” juveniles and females is distinguishable from that of *T. brichardi*: while the yellow(ish) bars in *T. brichardi* are two or more scales wide (at the upper lateral line), in *T. sp.* “Mpimbwe” the bars are white to very pale yellow and are only one scale wide.

### **Tropheus of doubtful status**

I have already hypothesized that the so-called “Ilangi Moorii” is the result of a recent hybridization. Two other morphs of doubtful status were found in the central part of the lake along the Mahale mountain range. I accidentally photographed one of them in a group of *T. annectens* at Mabilibili. Although I have dived several more times at Mabilibili since then, I have failed to relocate that reddish morph. It could be the same form Schupke (2003) reports as “Karilani Red,” although I have never found it at Karilani either. Without the fish in hand, it is difficult to say anything about its status, but I would not be surprised if it were a rare cross between *T. sp.* “Black” (the “Kirschfleck”) and *T. moorii*, which are sympatric at Mabilibili.

As for the second doubtful morph from this part of the lake, imported as “Tropheus Red Belly,” we have a much better idea of what it could be. Egger et al. (2007) analyzed the DNA of six specimens of “Tropheus Red Belly” from Mabilibili. When nuclear DNA probes were used, the six “Tropheus Red Belly” formed a coherent group as a sister clade to all *T. sp.* “Black” species in the analysis. However, when mitochondrial DNA was analyzed, “Tropheus Red Belly” appeared as a sister clade to *T. sp.* “Red” and *T. moorii*. Egger and his colleagues concluded that “Tropheus Red Belly” is of hybrid origin

and that one of the parents is probably *T. sp.* “Black” (“Kirschfleck”), and that the other parent is of uncertain origin. The mitochondrial DNA pointed to *T. moorii* as a possible parent, and that species also occurs at Mabilibili. However, when I examined photographs of “Tropheus Red Belly” (they look all different), I noticed some specimens with a color pattern like that of *T. annectens*. If the reddish morph I photographed at Mabilibili is a possible hybrid of *T. moorii* and the “Kirschfleck,” it is unlikely that “Tropheus Red Belly” is a hybrid as well. The only other alternative is that *T. annectens* is the second parent to “Tropheus Red Belly,” because there are no other *Tropheus* species found at Mabilibili.

The Mahale shore is at the crossroads of all three lake basins, and when the water level rises after a long period of drought, the endemic *Tropheus* species in either paleo-lake meet at Mahale. The shoreline across from Mahale is mostly sandy and thus not a suitable habitat for *Tropheus*. We have seen that there are three different *Tropheus* species at Mabilibili, but at Luagala Point I found four *Tropheus* species sympatrically: *T. annectens*, *T. duboisi*, *T. brichardi*, and *T. sp.* “Black.” If there is any place in the lake where hybridization between *Tropheus* species occurs, it must be where there are the most species present. 🐟

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Other Great Feeding Options!



conducted by Hans-Georg Evers • It is the beginning of December and there is snow on the ground. The AMAZONAS team has fought its way through the mud of the North German Plain to reach the tranquil suburb of Kiel and visit Mathias Eberhardt and his girlfriend, Stephanie, and their basement full of *Tropheus*. Mathias, a soldier, has just “shipshaped” the basement after returning from a six-week mission to Afghanistan.

## An interview with

# Mathias Eberhardt

Once a *Tropheus* lover, always a *Tropheus* lover!



Mathias Eberhardt in front of one of his many aquariums.

**AMAZONAS:** Howdy, Mathias. Did you properly clean all the glass?

**Mathias Eberhardt:** Hello there. Come along and see for yourself. However, you will have to figure out how to take pictures here. The aisles are quite narrow.

**AMAZONAS:** Right! It's lucky you are so slim. Obviously, you are good at setting floor tiles.

**Mathias Eberhardt:** (Laughs) True. My aquariums don't have substrate, but tile floors. In the lake, *Tropheus* live over stones and rocks, so tile works well for them and makes it easier to control the snails. *Tropheus* need to be fed a lot to provide enough for the weaker animals in each group. Over sandy or gravel substrates, you soon have a veritable snail invasion. Too many snails

pollute the water, and *Tropheus* are my passion, not snails.

**AMAZONAS:** Makes sense. What do you feed?

**Mathias Eberhardt:** I feed a dry food mix: 50% of Robert Guggenbühl's grower's flake, 25% krill flake, and 25% Tropical Spirulina Flake. *Tropheus* are grazers and require a high proportion of plants in their diet. I also use the pea and shrimp mix [described at [www.Reef2Rainforest.com](http://www.Reef2Rainforest.com)]; however, I use twice as many peas.

**AMAZONAS:** How long have you been working with *Tropheus*? It's not every day that we see such a collection of *Tropheus* variants.

**Mathias Eberhardt:** I started in 1989 with a group of *Tropheus duboisi*. I still have 17 of the

original 41 animals from 1989. At the ripe old age of 23, these animals produced 26 more juveniles in December 2012. So much for estimating the life expectancy of *Tropheus*.

Before that I kept Malawi cichlids, and until 1998, *T. duboisi* were my only *Tropheus*. Then I switched to Tanganyikan cichlids—the *Tropheus* fascinate me the most. Once I had the *T. duboisi*, I immediately started to think about setting up more tanks so I could keep other variants.

In my current system, I always keep about 40 variants, strictly separated from each other in species tanks. In addition, I have some Mbuna from Lake Malawi and Loricariids—my second passion—in the top tanks.

**AMAZONAS:** Why do you separate the species and morphs?

**Mathias Eberhardt:** *Tropheus* species cross-breed with each other. I've even had hybrids of *Metriaclima lombardoi* and *Tropheus duboisi*. The general school of thought says that *Tropheus* forms from the north of the lake do not cross with those from the south, because their

behavioral biology is too far apart. But ever since my *Tropheus* sp. "Ikola" (north) successfully crossed with *Tropheus moorii* "Murago" (south), I've known that wasn't true.

I am not interested in mass production; it is enough for me if a variant propagates so that I can keep it going and give away a few animals every now and then. With species tanks, this is not a problem, because some young fish always make it among the stone structures. For rare variants I make more of an effort—I catch the egg-bearing females and put

Above: The aisles in Mathias's basement fishroom are very narrow.

Below: *Tropheus annectens* "Kekse" is Mathias's current favorite. Note the absence of sand, which he says can lead to snail problems.





Above: The tanks are illuminated with LED spotlights, creating a diffuse light on the sides.

them into 5-gallon (20-L) tanks, where they can hatch the little ones alone.

**AMAZONAS:** So is the once-popular “shaking out” and artificial hatching now passé? And how do you know when you need to move a female? They should not be removed from the group for too long if the subsequent reintegration is to be successful, right?

**Mathias Eberhardt:** Well, in the 1980s and 1990s, particularly the new variants were very expensive. Breeders could earn good money if the females were ready to spawn again sooner. Therefore, they caught the females, extracted the eggs, and hatched them separately. However, such artificially reared fish are subsequently difficult to breed because the females often eat the eggs before they learn to release the fry. Naturally reared fish do not have this problem and carry out brood care reliably

Below: “Namansi Red” lives in the upper layers of Lake Tanganyika.



from the beginning.

I observe my groups closely. In about 80 percent of the variants, the hatched juveniles turn dark and can be seen through the transparent skin of the female’s throat. Toward the end of maternal care, the female is often slightly tilted, with her head down. This is the right time to separate her. For a few days, I can keep her together with the fry. In separate tanks, I have observed that the female takes the fry into her mouth in the evenings for about 20 days.

It is true that sometimes there is quite a brawl when females are returned to the tank. I found it advantageous to return them either at night or during the turmoil of a water change. However, this is nothing compared to adding males—they don’t stand a chance because they are chased to death. That is why it is so important to maintain the greatest possible number of individuals per group from the beginning.

**AMAZONAS:** A rather expensive indulgence, right? Among old aquarists, *Tropheus* still have the aura of an exclusive, very expensive fish that is hardly suitable for aquariums because of its aggressiveness.

**Mathias Eberhardt:** I’ve given up trying to dispel this stubborn prejudice. Earnest *Tropheus* friends have long since proven that our fish are quite suitable for the aquarium and can be maintained successfully for many years. My group of *Tropheus duboisi* is the best example.

The prices today are not nearly as astronomical as they were in the days of the Tanganyika boom. Wild specimens are still very expensive, but a tank-raised fish costs only about 20 to 35 percent of the price of a wild-caught animal. Some variants, such as the popular *T. moorii* “Red Rainbow,” are not very productive, and sometimes I only get one baby per brood. My record is 42 fry from a female of *T. sp.*



“Red” from Moliro. Typically, there are about 10–15 offspring per brood.

Wild specimens cost \$33–80 (€25–60) per fish. It gets expensive because it is best to procure as many animals as possible. I usually purchase at least 20–25 animals—five males and the rest females—sometimes even more. There are occasionally some losses during the acclimatization and settling-in phase. Even though the losses are negligible, it is sad to lose any animal. The males fight to establish rank no matter how big the aquarium is. Even 10-foot-long (3-m) tanks are not sufficient for some variants.

The larger the group, the more spread out the aggression. The number of males is crucial. Unfortunately, a significant female surplus is often preferred. However, for aquarists who do not breed in quantity, the sex ratio is secondary. I once had a group of *Tropheus* sp. “Mpimbwe” from Cape Msalaba in Tanzania (trade name “Mpimbwe”). I had bought 56 juveniles ranging in size from 0.8 to 1 inch (2–3 cm). I discovered later that the male to female ratio was 49:7. Nevertheless, I got about 200 fry per year. Because

there were so many of them, the males kept busy with each other and left the females to spawn in peace. Unfortunately, the group passed away after I moved them, but up to the end, everything was peaceful.

**AMAZONAS:** Sure, in the lake the animals can escape into other areas that are larger than any aquarium.

**Mathias Eberhardt:** Correct! I have made two trips to Lake Tanganyika and one to Lake Malawi. For me it was very enlightening to see that the territory of a male comprises at least

Above: A second form of Namansi (“Fiery Fry”) lives in the deeper water below the area inhabited by “Namansi Red.”

Below: Mathias’s passion for *Tropheus* began with *T. duboisi*, shown at 23 years of age in his home.



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21.5 square feet (2 m<sup>2</sup>). Additionally, this spreads three-dimensionally up and down along the littorals (shores).

In the lake, I observed that the variants change depending on water depth. One form swims in the shallows, and beyond a certain depth it is replaced by another form. I have two forms of *T. sp.* "Namansi": "Namansi I" ("Namansi Red") lives in the shallow area and is replaced at about 33 feet (10 m) by "Namansi II" ("Fiery Fry"). While snorkeling at the lake I wondered why I could spot two different-looking fry, but only one "type" of adult animal. That was one reason I wanted to dive into deeper water.

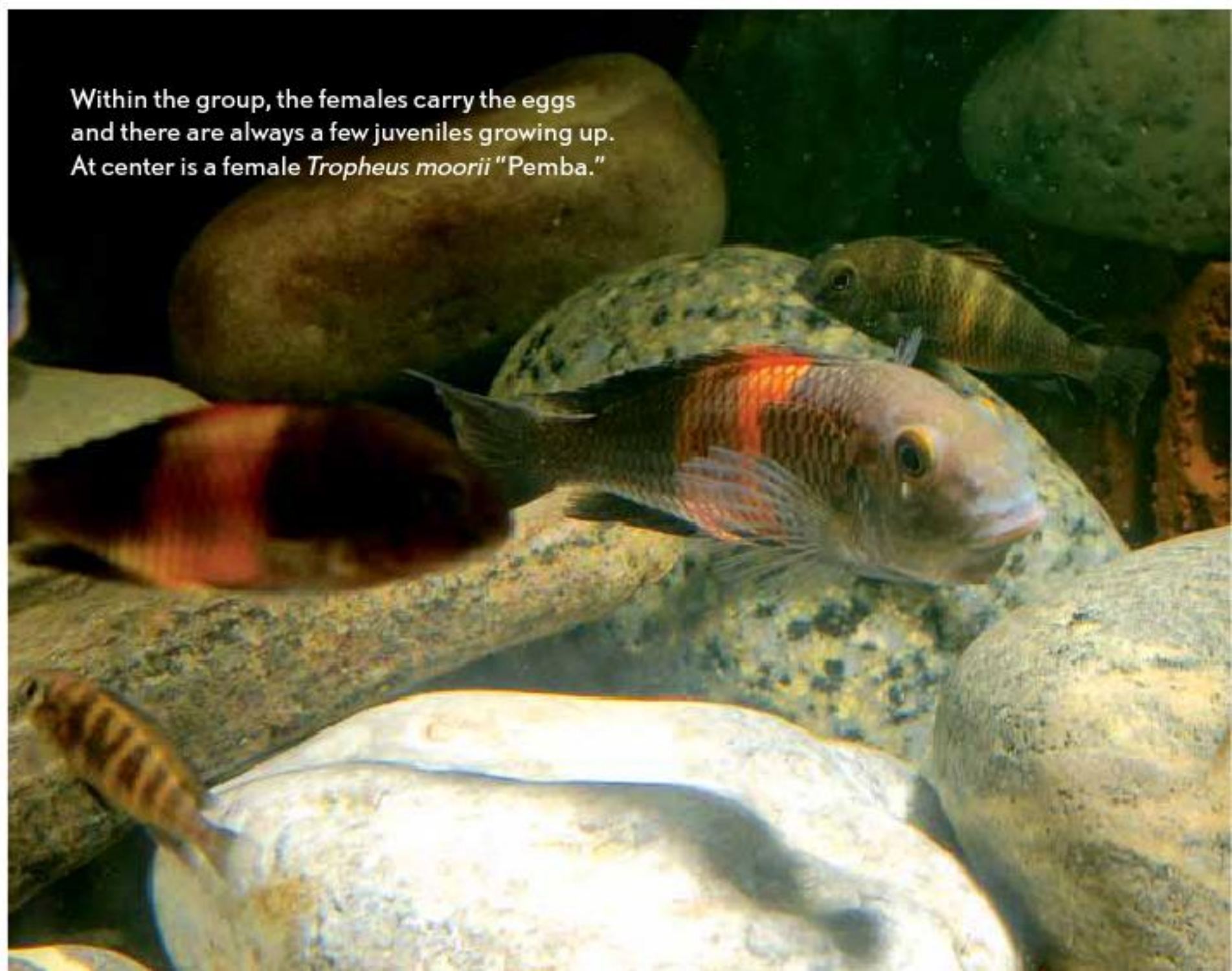
**AMAZONAS:** It sounds like there are many such stories about the *Tropheus* species, and you have written about two of them for this issue. As an old hand, you obviously have your favorites. Are there still many *Tropheus* enthusiasts among us with whom you can share your passion?

**Mathias Eberhardt:** The *Tropheus* hype has certainly ended here in Europe. In the U.S. and in Asia, the animals are much more popular and more common in the hobby. This is partly due to the general trend in the hobby, but there are also more choices now. When the genus was a big deal, there were only about 20 variants, which were spread among all the breeders and fans. We have access to over 100 forms today, and you would have to quintuple the number of aquarists to equal the demand that existed in the old days. I also think that the growing knowledge of the proper maintenance of *Tropheus* species has increased their life expectancy. This makes life more difficult for dealers, but as fans we can view this as positive.

Getting wild-caught fish from the lake has also become much easier and cheaper than it was 20 or 30 years ago. This development should give us pause, both because amateur and professional breeders have trouble selling their animals and because it puts a burden on the natural resource.

On some forums there is extensive shop talk and hardcore discussion, but there may be five people per variant who seriously keep them for a long time. Like many other species, *Tropheus* spp. are subject to certain fashion trends. With an estimated 150 or more known variants in the lake, that is no wonder. New forms come and go, and some older forms are then lost to the hobby. However, the impact on the lake is even more troubling.

Within the group, the females carry the eggs and there are always a few juveniles growing up. At center is a female *Tropheus moorii* "Pemba."



**AMAZONAS:** In what way? Is it due to overfishing and environmental issues?

**Mathias Eberhardt:** Exactly—for example, take the Burundi coast. Civil war and famine have driven crowds of people to the lake. The wood and vegetation are gone, and sediments and rubbish are being washed into the lake. It is estimated that 70 percent of the aquatic fauna in the lake have been destroyed. The large predators are overfished and the herring cichlids of the genus *Cyprichromis* have increased. There have always been large flocks of them, but now there are hordes.

The ornamental fisheries have also had a detrimental effect. It has been proven that fish from distant localities have been released near fishing stations. This has probably led to “natural hybrids.” Some species, such as *T. sp.* “Ilangi Moorii” and the popular *T. duboisi* “Maswa,” have been overfished, and that has decimated stocks. Other forms have invaded their habitats and mixed things up. Since these practices have become known to aquarists, they are no longer tolerated.

There has been some oil exploration along the lake for quite a while. An old ferry was recently modified for this purpose. If oil is discovered and a leak occurs, it will be disastrous. This paradise, with its clean water, would be lost forever. Even if there is no spill, the prospect of work in the oil industry will attract a lot more people to the lake, and pollution from traffic and sewage will compromise the lake. From experience, I know that almost all of the fishes in Lake Tanganyika are very sensitive to contamination. To make matters worse, the water temperature in the lake has increased by one or two degrees in recent years. I don’t like to be a prophet of doom, but for Lake Tanganyika, as for so many places on Earth, things are not looking good.

**AMAZONAS:** That is disturbing. On a less distressing note, what do you find most exciting in your work with *Tropheus*?

**Mathias Eberhardt:** I try to maintain the variants that I keep as long as possible. For the last few years, I’ve been focusing on the striped forms. *Tropheus annectens* “Kekese” is a real favorite of mine. New forms are always emerging, and old morphs lose their caché, but I take my time making changes. I do hope that in the next few years some new types will emerge from the Congo coast. I am not yet finished with the *Tropheus* species. Once you are addicted to these fish, it isn’t easy to stop. Once a *Tropheus* lover, always a *Tropheus* lover!

**AMAZONAS:** Well said, Mathias! Thank you for this interview and keep having fun with your *Tropheus*! 🐟



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Wild-caught *Tropheus* sp.  
"Red Belly" with cheek-spot

# *Tropheus* sp. "Red Belly": A HYBRID OR A VALID SPECIES?

by *Mathias Eberhardt* • The origin and biology of *Tropheus* sp. "Red Belly" are obscured by more myths than almost any other *Tropheus* color variant. Is this form a distinct species, a morph, or a hybrid? This article and its conclusions are not the result of scientific work, but are based on my own observations in the lake and my experiences as a *Tropheus* keeper.



Top: Wild-caught *Tropheus* sp. "Red Belly" without cheek-spot (in distress colors).

Bottom: Aquarium hybrid between *Tropheus* sp. "Bulu Point" and *T. sp.* "Kibwesa" without cheek-spot.

*Tropheus* sp. "Red Belly" forms a very small natural population in the south of the Mahale National Park in Tanzania, specifically between Kibwesa and Bulu Point. The animals stand out because of their unique and variable coloration and their distinctive cheek-spot.

In addition to *Tropheus* sp. "Red Belly," two more populations are found in this area of the lake. *Tropheus* sp. "Kibwesa" and *T. sp.* "Bulu Point" are named after the respective locations where they occur. During several dives in the area, I was able to observe that *T. sp.* "Red Belly" courted only fish of the same form and relentlessly drove *Tropheus* sp. "Kibwesa" and *T. sp.* "Bulu Point" from the territories.

These observations contradict the theory circulating among hobbyists that *T. sp.* "Bulu Point" have been disposed of in the area around Kibwesa. According to this theory, *T. sp.* "Bulu Point" animals were caught at Bulu Point for export. On the boat ride from Bulu Point to the fishing area around Kibwesa, the best-looking fish were separated from the less attractive animals, which were thrown back into the water near Kibwesa. The form *T. sp.* "Red Belly" allegedly emerged from the pairings of these released *T. sp.* "Bulu Point" and the local *T. sp.* "Kibwesa."

If this were true, *T. sp.* "Red Belly" would be a hybrid, not a separate population, and we would expect *T. sp.* "Red Belly" to accept both *T. sp.* "Kibwesa" and *T. sp.* "Bulu Point" as mating partners. However, observations in the wild outlined above do not bear this out.



*Tropheus* sp. "Bulu Point"



This wild-caught *Tropheus* sp. "Red Belly" has a cheek-spot.

### Hybridization experiments

In September 2006, I received a wild-caught male *T. sp.* "Kibwesa" along with some *T. sp.* "Red Belly." I put this male in a tank with about 70 female *T. sp.* "Bulu Point." Among the females was one animal that differed from the others in color and spotting pattern—one of her red spots was almost oval.

The animals were kept together for about a year. During this time, I observed that courtship and spawning occurred three times between the male and this differently colored female of *T. sp.* "Bulu Point." Some of the emerging fry from these spawns—I call them false *T. sp.* "Red Belly"—had a cheek-spot, typical for both *T. sp.* "Red Belly" and *T. sp.* "Kibwesa."

In recent years, there have been repeated pairings of these hybrid animals with either the differently colored female *T. sp.* "Bulu Point" or the male *T. sp.* "Kibwesa." Over time, some of these backcrosses of the false *T. sp.* "Red Belly" developed a spotting pattern, coloration, and cheek-spots very similar to that of the wild forms of *T. sp.* "Red Belly."

In 2010, I received a shipment of four wild-caught *T. sp.* "Red Belly." I put these animals in an aquarium with female *T. sp.* "Bulu Point" to cross both populations. In the following weeks and months, there were no matings. I could see that the *T. sp.* "Red Belly" males completely ignored the *T. sp.* "Bulu Point" females, even when the females had extended ovipositors. There was not even an attempted mating!

### Purchase with caution

Over the years, I have seen several live putative *T. sp.* "Red Belly" in the aquarium (or pictures of them). Many of them turned out to be hybrids that showed characteristics of both *T. sp.* "Kibwesa" and *T. sp.* "Bulu Point." The younger the animals and the less pronounced certain features were, the more difficult it was to make a clear statement as to whether these animals were hybrids or of natural origin.

Since wild-caught *T. sp.* "Red Belly" command quite a high price, it is a good idea to be cautious when making a purchase and weigh the risks. Whether the decision to buy was correct only becomes obvious with time, when typical features develop more clearly and the animals can be observed to reject mates from other populations. When they breed among each other, subsequent generations can also provide answers. If young animals grow up and can be identified externally as *T. sp.* "Kibwesa" or *T. sp.* "Bulu Point," their parents were most likely hybrids. 🐟



Normally colored *Tropheus moorii* from Isanga Bay.

## *Tropheus moorii* “Golden Kalambo”: A FALSE COLOR FORM FROM ISANGA BAY

*article and images by Mathias Eberhardt* • In my experience, false-colored animals with yellowish or reddish coloration are extremely rare among the *Tropheus* in Lake Tanganyika. When diving, you have to be very lucky to get one or more animals in front of your camera lens. Even more skill is required to capture one of these rare specimens with a net. As a result, these animals are highly sought after.



A happy coincidence led to this picture of *Tropheus moorii* “Golden Kalambo” in its habitat.

During more than 10 hours of diving in Isanga Bay in the south of Lake Tanganyika, I have seen only a few *Tropheus moorii* that were at least partly colored yellow. There was only one animal with a very high proportion of yellow. To enjoy such “top animals” as an aquarist, you might travel to Lake Tanganyika and try your luck with catching these fish. Or you can let others catch them and buy them at the lake.

Depending on supply and demand, such prized fish can be very expensive. And keep in mind that in addition to the purchase price, you will have to pay shipping charges and, depending on the country, import fees. It is much easier if you know someone who knows someone who owns these animals and breeds them.

### **Isanga Bay and Kalambo**

The *Tropheus moorii* “Golden Kalambo” is a false-color variant (also known as “OB Moorii”) that occurs in the Isanga Bay population. According to several Lake Tanganyika travelers, this *Tropheus* form used to live only in this particular area in the south of Lake Tanganyika. About half a mile (800 m) further north is the mouth of the Kalambo River; *Tropheus moorii*



*Tropheus moorii* from Isanga beginning to change into a "Golden Kalambo."

"Golden Kalambo" is now found there as well. However, it is considered a fact that no natural color mutants occurred there until a few years ago, so the question arises: how did they get there?

In the 1990s, a breeder on Lake Tanganyika tried to create a stable strain of false-colored animals. For breeding purposes, *T. moorii* "Golden Kalambo" were collected in Isanga Bay. However, the process of color change only begins in the adult state, around the age of about two years. The process can be completed in a few weeks but can also take several years.

In the belief that the mutation was not genetically fixed, juveniles of *T. moorii* "Golden Kalambo" that emerged from the breeding group were released at Kalambo. These do not visually differ from the animals without the OB trait that were already living there. After some time, it was observed that some animals began to change color. Presumably these were the juveniles of the breeding group, which had been less than two years old when they were released.



Right, above: This male is in the middle of a color change and can be described as a *Tropheus moorii* "Golden Kalambo."

Right bottom: Female *Tropheus moorii* "Golden Kalambo."

*Tropheus*  
habitat  
in Isanga  
Bay.



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### The color change process

In October 2009, I received a pair of *T. moorii* “Golden Kalambo” and about 30 fish without the color “aberration” from an aquarist. Of this group, which contained only adult and semi-adult animals, three females have begun turning into “OB Moorii” within the last three years. In two of the fish the process took place within weeks, but in the third fish it has been going on for more than two years.

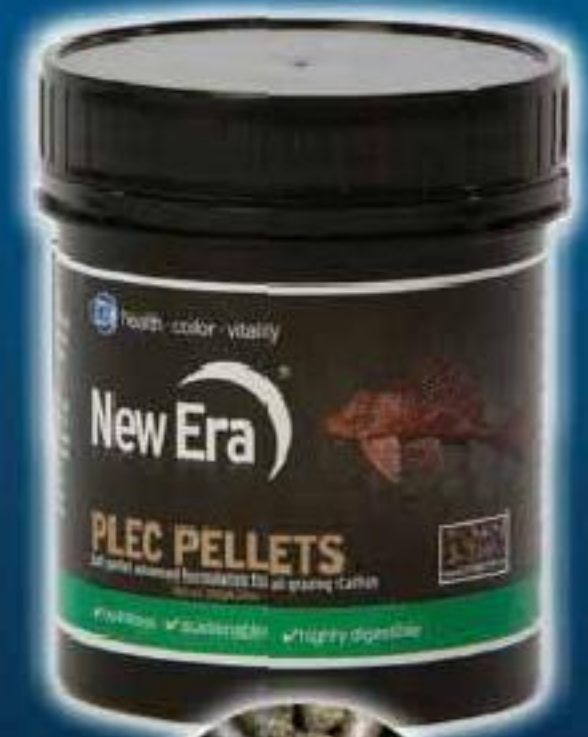
The color change usually begins with a black spot in the dorsal fin. It continues with the transformation of the faint stripe immediately in front of the dorsal fin that is barely visible in adult animals. If the stripe does not recolor in the same time period as the spot, the entire process stops, according to my observations.

Two years ago, I received another four animals, so now I can call 10 *Tropheus moorii* “Golden Kalambo” my own, including an animal I caught myself in 2009. The fish live together with around 20 normally colored females. All males in that tank are mutants, which ensures that at least one parent is an OB animal.

I have made the observation that until now there has been no mating with animals that have not also exhibited the off color or changed color at a later date. Whether I am correct in this observation and what percentage of the raised juveniles will actually recolor to *T. moorii* “Golden Kalambo” remains to be seen.

In any case, these are beautiful animals, definitely worth the effort, and the sight of them fascinates me time and time again. 🐟

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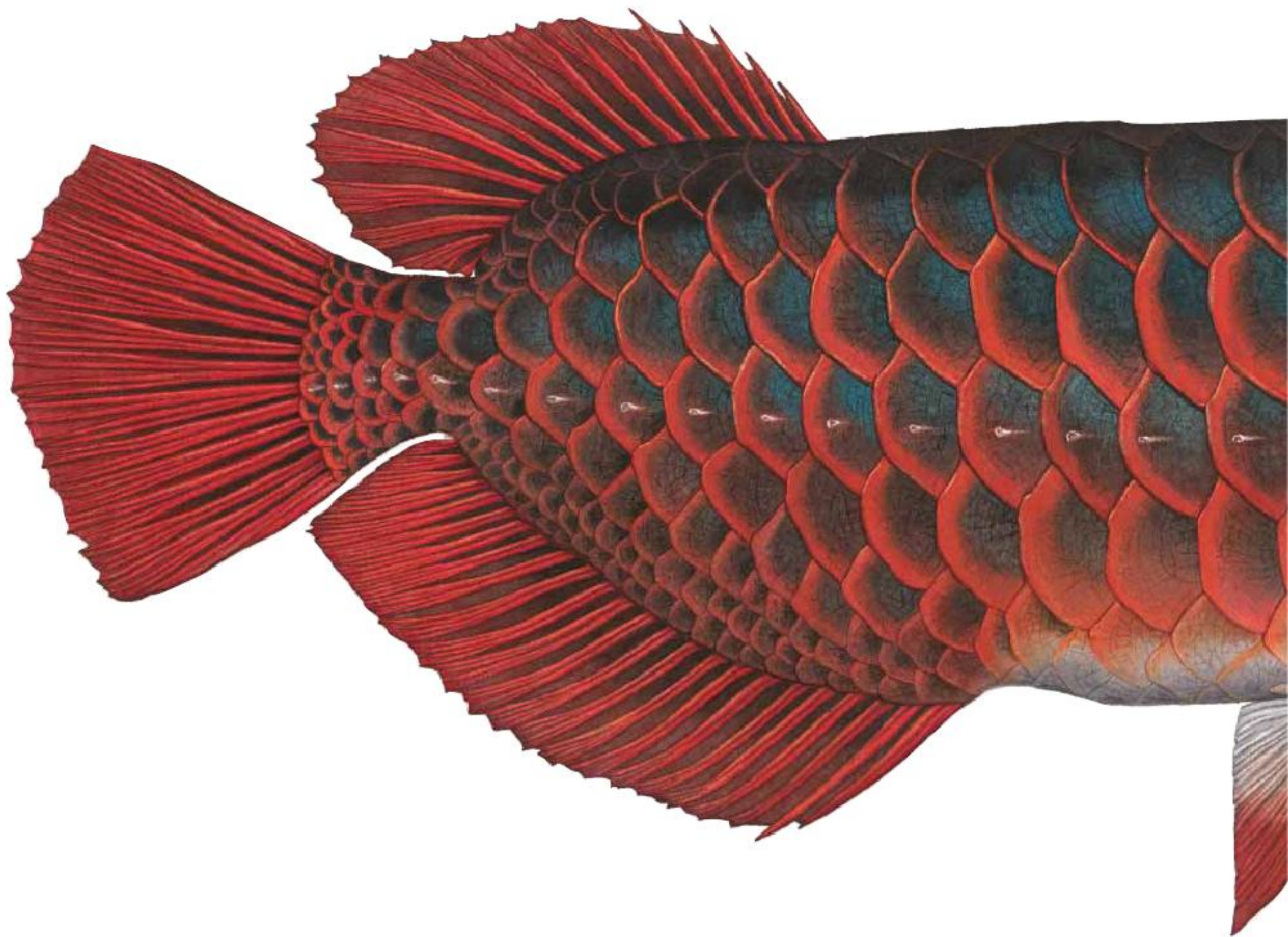
  
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# WILD



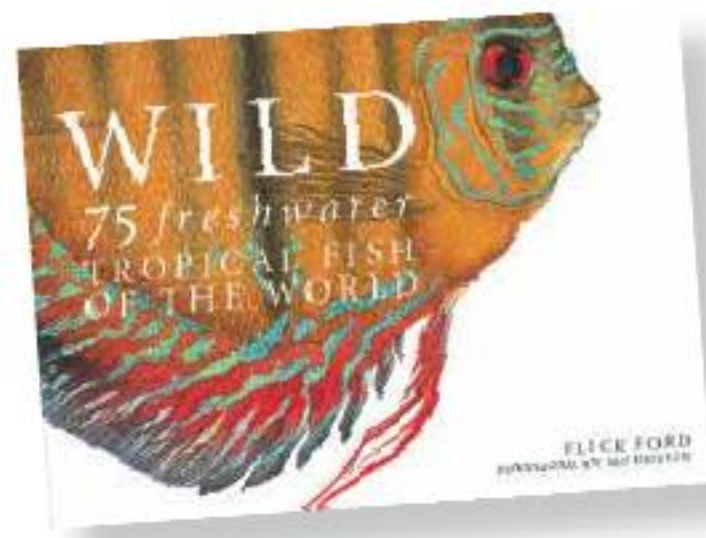
**FOREWORD** — I think robot fish will be pretty cool. I say “will” instead of “would” because I do believe it’s going to happen, and probably sooner than anyone would expect. A team of people from FILOSE (Robotic Fish Locomotion and SENSing) are making major headway into one of the most important elements, the lateral line. From their website: “FILOSE is a research project financed by the Seventh Framework Programme [FP7]. We investigate how fish sense the flow around them and react to the changes in the flow pattern. Then we want to build robots that act in the same way.”

It won’t be long before all this is perfected and miniaturized for the fish tank. Imagine being able to not only look at your fish in the tank, but also, maybe, direct their movement, change their color, and never have them get sick or die.

Not for you? Other than just the novelty of seeing it, me either. But it does bring to mind some bigger questions: What is this hobby all about? What’s in its future?

—Continued on page 60

# 75



## Freshwater Tropical Fish of the World

by Flick Ford with a foreword by Mo Devlin



Super Red Asian Arowana,  
*Scleropages formosus*

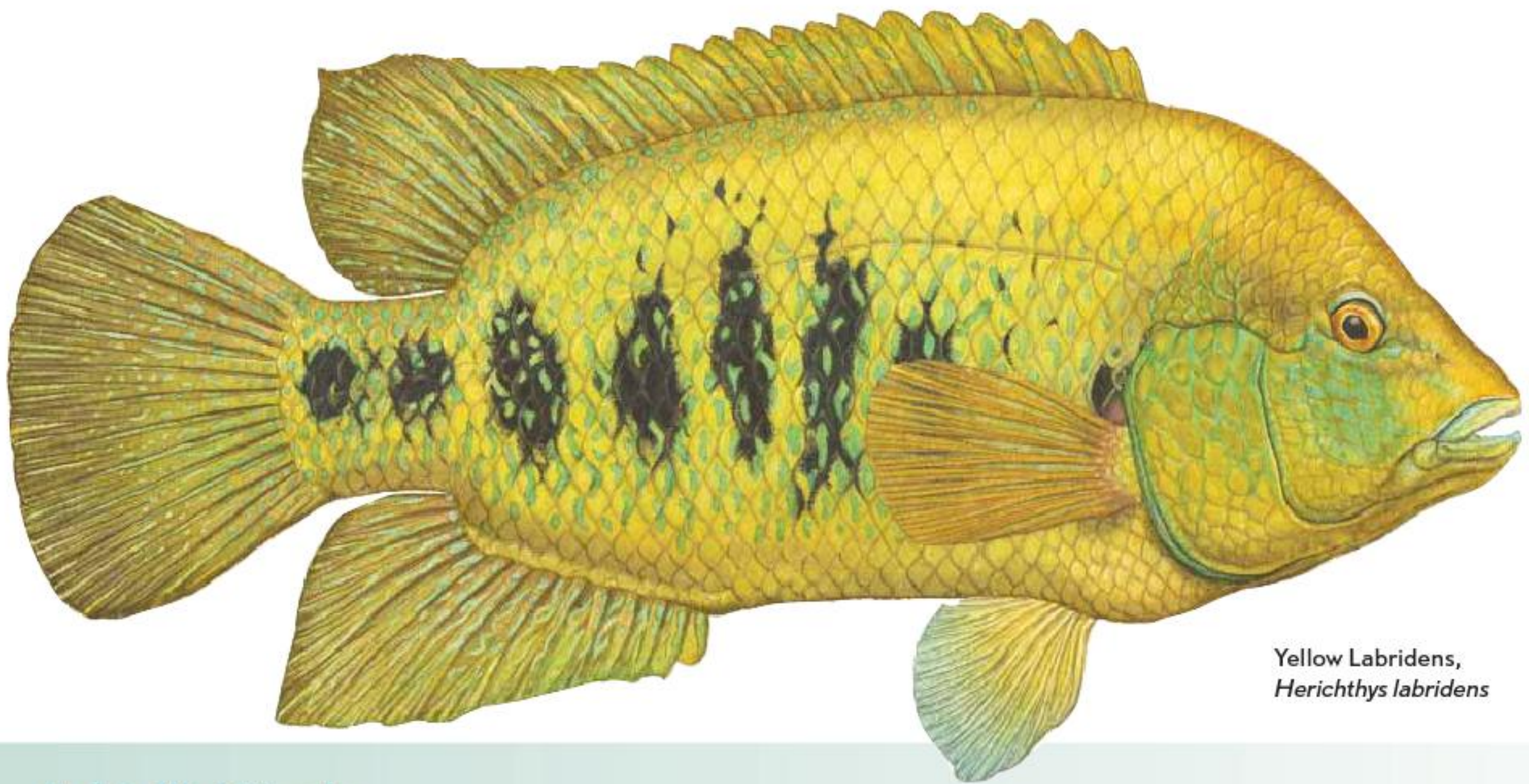
### Arowana

The Asian Arowana is native to Vietnam, Cambodia, Thailand, Myanmar, Borneo and Sumatra. It is found in ever-decreasing numbers in blackwater lakes, swamps, flooded forests and rivers with slow currents and overhanging vegetation. There are several regional variants found in nature; pictured is the popular Super Red morph known only from a few locations in Western Borneo. All Asian Arowanas are very difficult to sex.

In the wild the Asian Arowana is a surface-feeding hunter that as a juvenile consumes insects. Adults are primarily piscivorous but also consume frogs, insects, lizards, birds, bats and small mammals. A wide variety

of foods should be offered in captivity to ensure good health. The Asian Arowana is not prolific. Slow to reach maturity, this paternal mouth brooder engages in a two-month courtship and spawns once per year to produce between thirty and eighty fry. The male provides extended brood care. While the Asian Arowana's wild habitat is often full of "jungle décor," in the confines of an aquarium soft, silky plants can provide security without the risk of injury.

Asian Arowanas are listed as Endangered on the IUCN Red List. Threats include illegal exploitation for the black market and ongoing habitat loss and degradation.



Yellow Labridens,  
*Herichthys labridens*

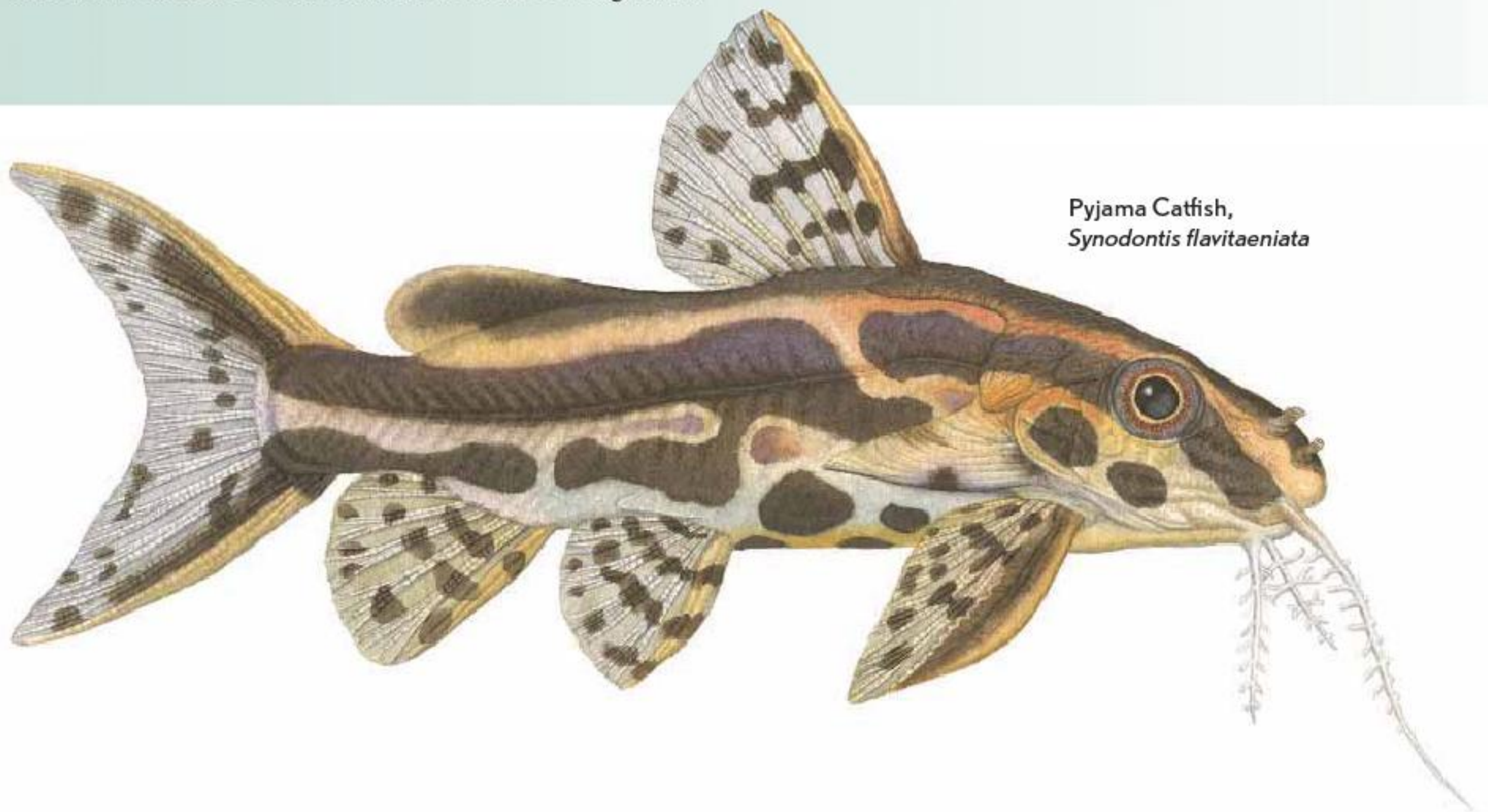
### Red-Bellied Piranha

Red-Bellied Piranhas are widespread and numerous throughout their range in South America. They are found east of the Andes in the Amazon River, Rio Paraguay, Rio Paraná and Rio Essequibo Basins and numerous lesser drainages, typically in whitewater. Red-Bellied Piranhas exhibit varied morphology even within geographic locations, as well as with age; however, the sexes are indistinguishable. The portrayal here is of a specimen with red/orange coloration and many gold iridescent scales that sometimes earn the fish the name “Gold-Dust Piranha.”

Red-Bellied Piranhas shoal in year-class schools with smaller fish foraging during daylight hours and the larger fish searching for food at dawn, dusk and early evening. They employ ambush predation, chasing down prey and scavenging dead organisms. Reptiles, seeds, plant matter and even fruit have been found in their dissected guts. In

the wild they form hierarchal groups of twenty to thirty individuals. In captivity they are shy and spooked, traits which require a lot of open swimming space and plenty of cover in order for them to settle into a stable social order. They spawn during the rainy season. Males dig out nests; females lay clutches of up to 1,000 eggs that are then fertilized by the male. Upon hatching, both parents guard the brood.

Twenty-six states in the U.S., as well as at least nine countries worldwide, prohibit the possession of piranhas. Illegal introduction into U.S. waters by irresponsible aquarists has added to myths and undeserved hysteria about this species. Like discus, piranhas are widely consumed by humans as a food fish in South America. The fish is currently not threatened in its native range.



Pyjama Catfish,  
*Synodontis flavitaeniata*

## Yellow Labridens

The Yellow Labridens is indigenous to Mexico, inhabiting clear water, deep thermal springs in the Rio Verde Valley and sections of the Santa Maria River apart from the main channel. Lacustrine populations breed year round, and riverine populations in May and June. The two forms are indistinguishable in morphology. In the painting opposite, a large male is depicted in non-breeding colors, a spectacular yellow with black spots and cyan markings.

In the wild, the Yellow Labridens feeds on mollusks, crustaceans, insects, plants, seeds and detritus. In captivity they are not fussy eaters but require high protein foods with carotene to display their best colors during breeding. They excavate breeding caves in nature but

will spawn in artificial caves and flowerpots in captivity. Labridens provide excellent biparental care for the fry for up to five weeks and stir up the debris on the substrate to feed them. In their natural habitat they are often associated with lily pads; however, in captivity housing them with large plastic plants, along with driftwood and rockwork for shelter and hiding, is recommended. The species is considered to be aggressive yet full of character, intelligence and interesting behavior.

The Yellow Labridens is listed as being in danger of extinction and is listed under the CARES Preservation Program as CVU (vulnerable, species facing a high risk of extinction in the wild in the medium term future).



Red-Bellied Piranha  
*Pygocentrus nattereri*

## Pyjama Catfish

The known native range of the Pyjama Catfish is the lower Congo River, the Stanley Pool in the Democratic Republic of the Congo and throughout the Congo River Basin. Their preferred habitat is the slower flows on the bottoms of rivers and streams as well as the bottoms of ponds and lakes. The species does not exhibit noticeable sexual dimorphism. The image shows a typical specimen known for its iridescent violet, orange and yellow hues and attractive patterning.

Pyjama Cats are members of the squeaker catfish clan. A study by Lechter et al., published in *BMC Biology* 2010, revealed that “the catfish use the squeaking sound to warn of predators and during competition between members of the species...catfish of all ages can communicate with

one another...hearing sensitivities increase with growth, but even the youngest fish are capable of communicating over short distances.” In the wild, Pyjama Cats are benthic feeders consuming mollusks, insect larvae, worms and organic detritus. In captivity, it has been reported that they relish some vegetable matter. They breed in flooded areas during the wet season and form pair bonds but provide no parental care for the brood.

Pyjama Cats are listed on the IUCN Red List as Least Concern. They are widespread throughout their range and there are no major threats to the species. They are commercially captured and exported for the aquarium trade. Captive breeding of the species is rare and commercial farming is not being practiced on a large scale at this time.

## Denison's Barb

Denison's Barb is one of India's most celebrated aquarium fish, yet seventy percent of the species' endemic population has been decimated by indiscriminate collection for the trade. Remnant populations of unknown number survive and the trends of decline are expected to continue. One can see from the bold coloration and torpedo shape what makes this species so attractive. Over a recent two-year period, Denison's Barb comprised sixty-five percent of India's freshwater tropical fish export, worth \$1.5 million.

Denison's Barb inhabits fast-flowing streams with high oxygen content and substantial stream bank vegetative cover. It is also found in pools with boulders and rocks with a gravel substrate. They find prey with the barbels on their lower lips, which are equipped with taste organs that help them forage for worms, insects, crus-

taceans, plant matter and organic debris. In the wild, spawning has been compromised by over-collection. Denison's Barb can be bred successfully in captivity. It is a typical non-demanding egg layer, a trait that gives some hope that the trade could depend on commercially bred fish. Still, conservation measures are paramount.

Denison's Barb is listed on the IUCN Red List as Endangered. Its range in Western Ghats is restricted and declining in habitat quality. Conservation efforts for the Western Ghats are under way with The World Wildlife Fund (<http://worldwildlife.org>) and the Wildlife Conservation Society (<http://www.wcs.org>). Plans for no-take zones and other regulations are in development along with the introduction of catch limits and allowable fishing gear.



Lemon Tetra,  
*Hyphessobrycon pulchripinnis*

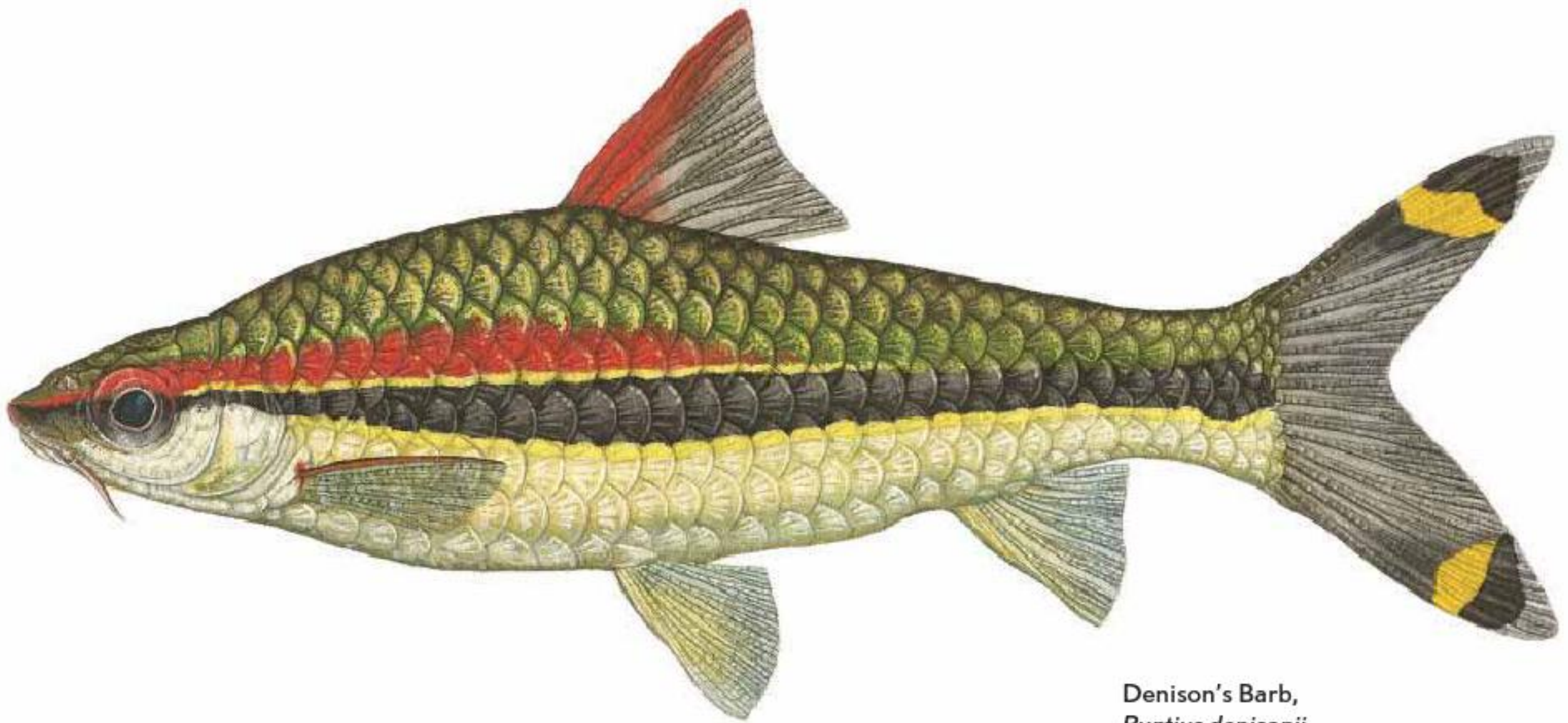
## Clown Loach

The Clown Loach is native to the inland waters of the islands of Borneo and Sumatra. The two populations are known to exhibit some differences in morphology. Females are generally more full-bodied. Pictured is a typical Bornean fish with some black in the pectoral fins.

Clown Loaches in the wild are potamodromous, moving from the main channels of streams and rivers into flooded habitat to breed in the rainy season. They are primarily carnivorous, feeding upon aquatic mollusks, insects, worms, small invertebrates, plant matter and algae. In captivity, provide a group of eight to ten fish a large enough home to grow. They can grow up to fifteen inches and live for twenty years, so keeping them is a substantial commitment. Enthusiasts of the species say the Clown

Loach's fascinating and often clownish behavior make it well worth the expense and time. Hobbyist breeding of this species is unreported at this time.

Though Clown Loaches are not listed on the IUCN Red List, floodplain swamp forests where they spawn are undergoing reclamation for land use, so much of their habitat has been degraded. It is now illegal in Indonesia to harvest large, mature Clown Loaches, since catch sizes have declined in recent years. Thousands of wild-collected fish are still sold, but in recent years farmers in Asia and Eastern Europe have been breeding them successfully. There is some concern that commercial breeders are selling hybrid *Botia* species (Indian Loaches) as Clown Loaches with different markings.



Denison's Barb,  
*Puntius denisonii*

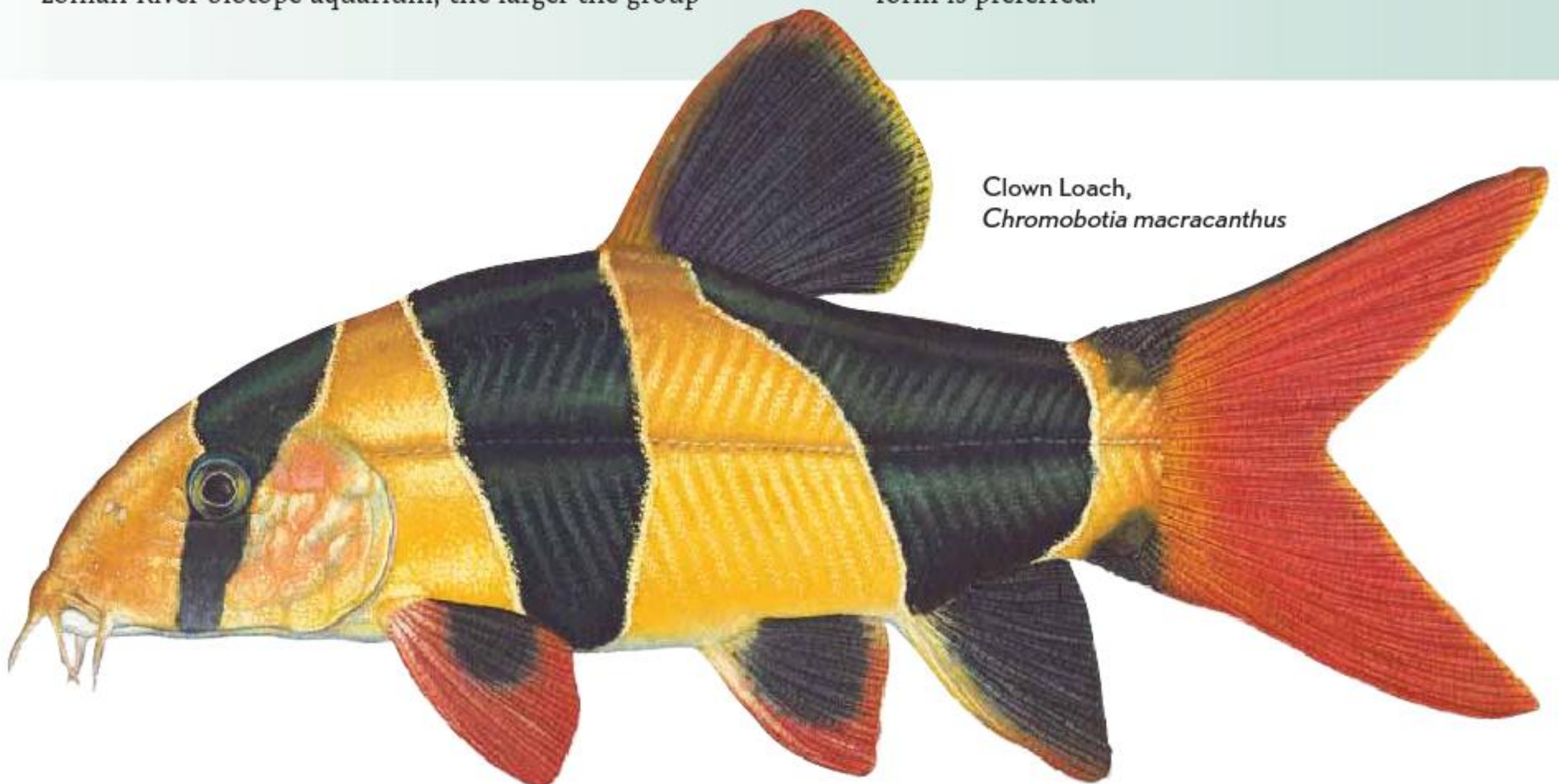
### Lemon Tetra

The Lemon Tetra is native to the lower Tapajós River Basin, its extant range. It is a benthopelagic riverine species found in shallow, moderate to slow-flowing, heavily vegetated areas of rivers and streams. It is one of the deep-bodied tetras; pictured is a male with a wide black border on the back of the anal fin.

Lemon Tetras congregate in large shoals of up to several thousand individuals that adopt rapid swimming strategies to evade predators and also spawn in these large congregations in vegetative cover. They are primarily carnivorous omnivores in the wild, consuming small invertebrates, worms, crustaceans and plant matter. In captivity they can create a spectacular display in an Amazonian River biotope aquarium, the larger the group

and tank, the better. Start with a sand substrate and add branchy driftwood, dried leaf litter and dense plantings with plenty of open swimming space. The water flow can be moderate. Males will select locations to display and the species can be spawned in a group, although eggs and adults should be separated for best results.

The Lemon Tetra is listed on the IUCN Red List as Least Concern. It is widespread and population trends are stable at present. Though harvested for the trade, overfishing poses no threat to the species. Populations have a minimum doubling time in the wild of fifteen months. Most Lemon Tetras come from commercial breeders. An albino form is available, but the attractive natural yellow form is preferred.



Clown Loach,  
*Chromobotia macracanthus*

—Continued from page 54

I've been an active member of the American Cichlid Association for many years. Recently we became embroiled in a discussion regarding the topic of hybrid cichlids and how they relate to the club. The overall stance of the club, and rightfully so, is that we very much believe in the conservation of the wild species of cichlid fish.

The reality is that many “aquarists” are finding interest in the hybrid, or, with regard to cichlids, the “flowerhorns.” Flowerhorns, in the truest sense of the word, are easily identified by their large, bulbous nuchal humps and radical, sometimes outrageous color. And from a marketing perspective I understand how a fish called “Red Mamon King Kong Parrot” might have a little more verbal sex appeal than the actual names, *Amphilophus citrinellum* plus, well...whatever else was mixed into the genetic soup.

The real challenge is identifying some of the not-so-obvious hybrid cichlids. Many of these are among the favorite wet pets in aquariums, like the “Red Devil,” most often a mix of *Amphilophus citrinellus* and *A. labiatus*. And then there are the unintentional hybrids, fish that for years were all part of one species but now, due to the doings of the “lumpers and splitters,” are members of multiple species. Take the “Convict Cichlid,” once *Archocentrus nigrofasciatus* but now split into thinner slices alongside *siquia* and *kanna*. So yesterday it was a pure species, but today...maybe it's considered to be a hybrid.

This conversation about hybrid cichlids evolved into a

bigger discussion—and really the heart of the matter—is it the end result we don't like or the means to the end? And there will likely never be a clear consensus.

Line breeding is a very long process where individual lines of fish with specific traits, for example, outstanding color or fin length, are isolated and bred to enhance those traits in the next and future generations of fish. It is no doubt not an easy way of creating a new fish, but certainly the end result is a fish that is not like its wild ancestor. The classic example, the Discus, is a fish that has been bred to display various colors and patterns. And there are many more examples, from the Super Red Severum to the long fin Albino Tiger Oscar.

In the end, the only difference between line breeding and simply crossing species to create “new” fish is the time it takes to get the job done. In both cases the fish are farther away from the wild phenotype due simply to the intervention of man.

Ongoing conservation projects like CARES (Conservation Awareness Recognition Encouragement Support) strive to ensure a future for species at risk. CARES was built on the principle of allowing everyone, whether a beginner or an advanced hobbyist, to be given a chance to play a role in, be a part of, and feel as if they are making a difference in the positive future of at-risk fish.

According to Claudia Dickinson, program founder, “In recent years, conservationists and scientists have come to realize that captive maintenance and procreation of species at risk, both within the country of origin and outside the country of origin, has become the quintessential answer for both short-term and long-term preservation goals. This has been successfully undertaken by aquariums and zoos. However, these facilities lack the necessary space and staff to come to the aid of all of the species in need of immediate help. It became apparent that this is a role in which we as hobbyists, with our combined total of thousands of tanks and shared experiences, can make a significant difference.”

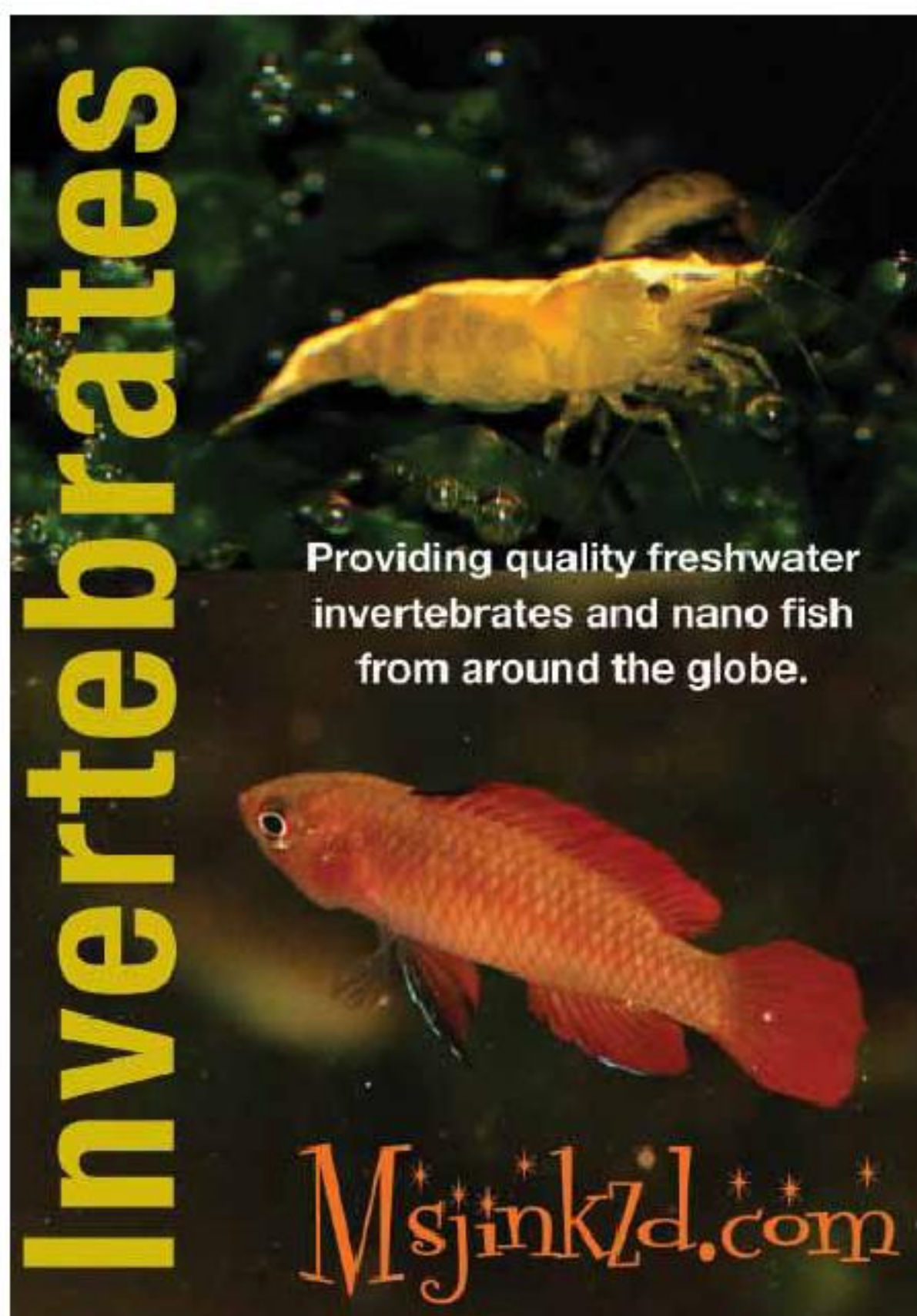
Sadly, some of the fish in this book have fallen off the map in the wild and now can only be seen in photographs and beautiful paintings like these. Robot fish and manmade specimens may remain part of the hobby mix, but only through conservation efforts inspired by shared knowledge like that found in Flick Ford's book *WILD*, and through our combined experience as hobbyists, can we contribute to preserving these species on the brink.

Enjoy the hobby. 🐟

—Mo Devlin

**Flick Ford** is a fine art natural history painter who frequently does portraits of fish. He maintains a 55-gallon aquarium containing native fish and plants in his Rensselaer County, New York, home.

**Morrell “Mo” Devlin** is an avid aquarist and photographer whose work appears in the regular AMAZONAS feature, *Underwater Eye*. He lives in Dallas, Pennsylvania.



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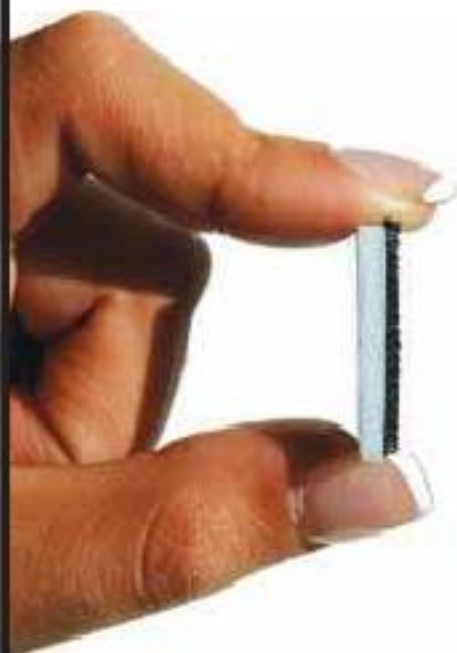
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The mating display of *Microphis deocata* is one of the most unusual among fishes.

# Pipefish Care 101

by Kurt Mack • Freshwater pipefishes are enjoying great popularity these days among specialized aquarists. But they are not easy to care for, and certainly not easy to breed. However, if you are able to provide suitable live food all year 'round, nothing stands in the way of trying to keep these exotic creatures.

Among my favorite subjects are the freshwater pipefishes *Enneacampus ansorgii*, *Doryichthys deokhatoides*, and *Microphis deocata*. According to what I hear from other pipefish enthusiasts, particularly Marion Zöller, the essential information given here also applies to other species, including *Doryichthys martensii*, *Ichthyocampus carce*, *Microphis leiaspis*, *M. cunclus*, and *M. brachyurus*.



Male pipefishes, like this *Microphis deocata*, carry their eggs in a brood pouch.

## Keep them in small aquariums

One or two pairs of the smaller species can be permanently accommodated in a standard 10-gallon (38-L) aquarium. For a pair or reverse trio (two males, one female) of the larger species, a 15-gallon (57-L) tank is sufficient. Even larger groups should not be kept in aquariums that are too large, since observation and adequate feeding can become difficult. For three to four pairs of *Microphis deocata* or *Doryichthys deokhatoides* a tank of about 30 gallons (113 L) is recommended.



The largest known freshwater pipefish, *Microphis boaja*, can grow about 1 foot (30 cm) long. It takes huge amounts of live food (mosquito larvae, crustaceans) to feed this species. The pictured specimen has a fungal infection on its tail and is unlikely to live.



*Microphis brachyurus*, which is approximately 8 inches (20 cm) long, is occasionally offered in the ornamental fish trade. Caring for them is no more difficult than caring for the other species, but they produce tiny eggs and juveniles and have not yet been successfully reared.

As a filter, Poret foam, placed at one end of the tank and paired with an air-driven lifter tube to move water, has proven ideal. Special aquarium filter foam with 45 PPI (pores per inch, extra fine pore) is best. The filter sheet can be rinsed or vacuumed with little effort. One of the main advantages of this type of filter is that it almost never clogs and can be left alone for a long time. For freshwater pipefishes, more regular cleaning is recommended. These fishes love the current, and this should be considered when placing the airlifter tube or the pump behind the foam.

External or internal power filters are not suitable for the care of freshwater pipefishes because they suck in too many food animals, have a relatively low filter volume to high flow rate ratio, and can also catch and injure delicate fishes.

You can hide a small heater behind the wall of foam. If the room temperature does not fall below 68°F (20°C) at night, you can switch off the heater and the lights with the same timer. As in nature, the temperature falls during the night and rises when the lights go on again. For lighting, a standard fluorescent tube is sufficient. Because of the natural color rendering, I prefer fluorescent tubes that simulate natural daylight.

Freshwater pipefishes prefer moderately hard water with a pH above 7. In general, salt is not necessary for

acclimatized animals. However, I do use salt to settle in new or diseased freshwater pipefishes to reduce the microbial content of the water. If salt is added for longer periods, the concentration should be diluted with water changes. I add more salt only after a few days. Regular water changes of 30–50 percent every five to ten days reduce the waste products and provide the system with new minerals.

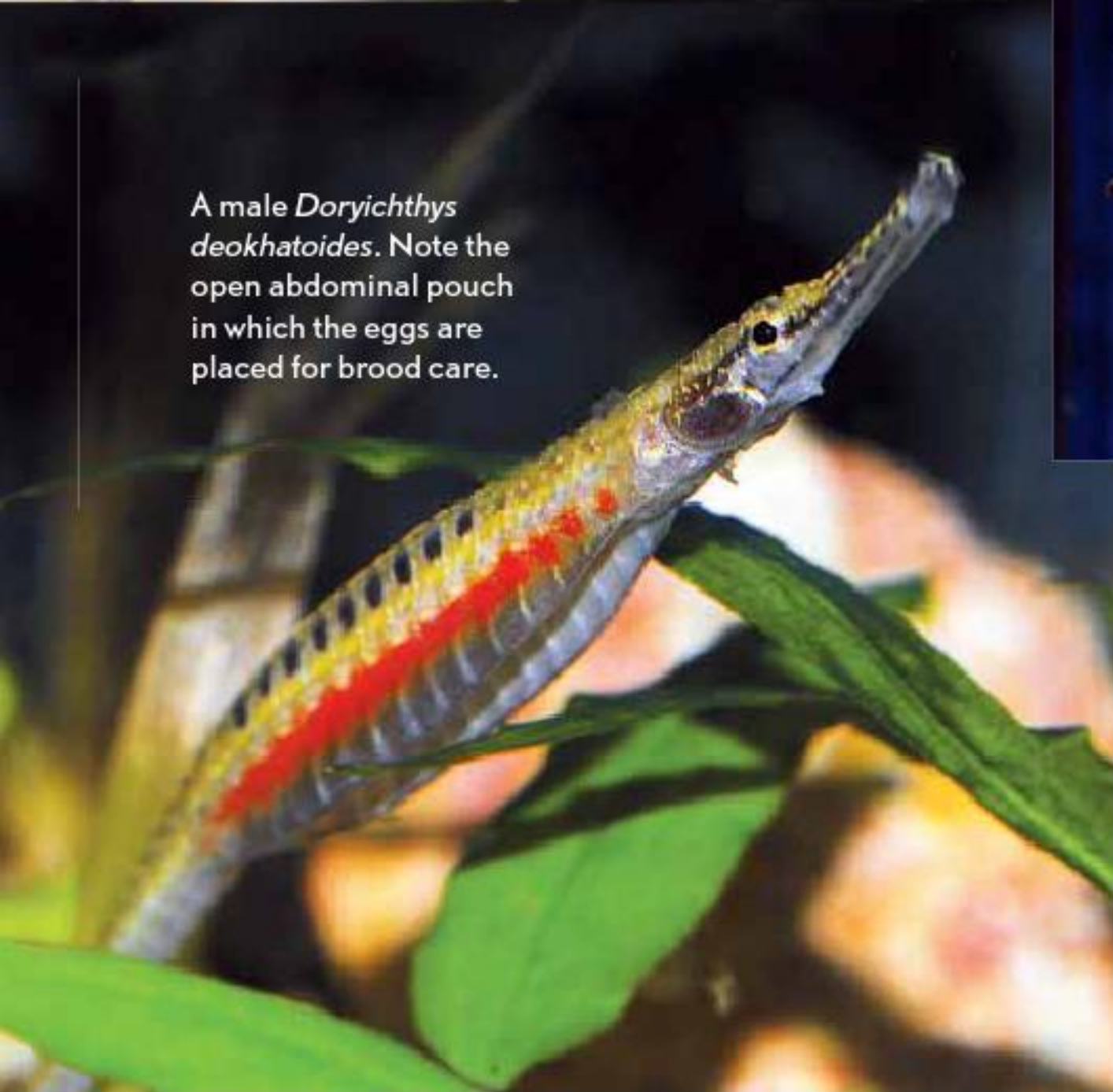
### Sparse decoration

I set up the aquarium quite sparsely: a half-inch-thick (1–1.5 cm) layer of rounded (natural) gravel with a grain size of 1–5 mm and one or more finely branched pieces of driftwood with attached plants are sufficient to make the pipefishes feel comfortable. I prefer root varieties sold as driftwood, mangrove wood, and bogwood. Roots that have been previously used in aquariums are ideal because they barely leach any acidifying substances into the water. Newly purchased wood should be soaked in water for

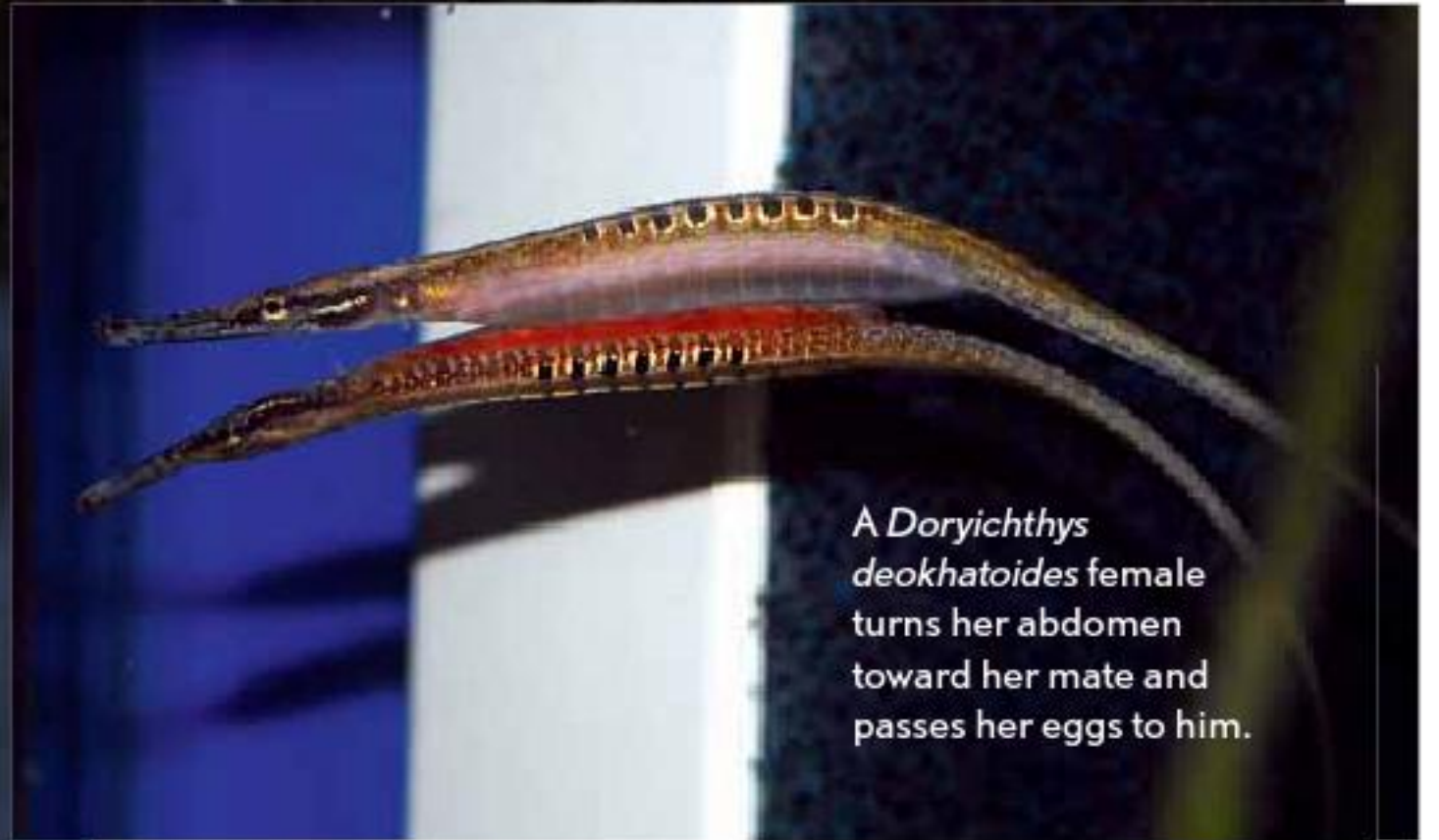
*Doryichthys deokhatoides* is an attractive small freshwater pipefish that is up to 6 inches (15 cm) long. During mating, the male (left) presents the brood pouch to the female.



A male *Doryichthys deokhatoides*. Note the open abdominal pouch in which the eggs are placed for brood care.



A *Doryichthys deokhatoides* female turns her abdomen toward her mate and passes her eggs to him.



several weeks with regular water changes.

The gnarled roots should only touch the gravel in small spots, so that no rotten areas develop. It is important, though, that the driftwood is stable and does not tip over. As attached plants, I prefer to use *Microsorium pteropus* (Java Fern) in its different growth forms, *Anubias* sp., and *Bolbitis heudelotii* (Congo Fern). Mosses are not so well suited because they collect detritus, complicate care measures, and quickly spread throughout the aquarium.

The aquarium should be clean, but not too clean! Every four to six weeks, the filter foam should be gently rinsed or vacuumed off lightly. Between these dates, you should vacuum the gravel with a gravel vac. Do not skimp in this regard, because if the pipefishes get sick or start to die, it is too late.

I use various types of Malaysian Trumpet Snails as functional animals that consume dead feed animals and the feces of the pipefishes to prevent rotting biomass. Ramshorn, pond, bladder, or apple snails are not suitable because they crawl onto the pipefishes and can chew them up. I also like to put a few small *Corydoras* sp. (e.g. *Corydoras habrosus*) in the aquarium; they consume worms and feed animals ignored by the pipefishes.

To prevent the emergence of algae, I use peaceful algae eaters such as *Otothyropsis piribebuy* (Brown Otocinclus), *Sturisoma festivum* (Whiptail Catfish), or *Ancistrus* sp. "Rio Paraguay," depending on the tank size. I do not keep other tankmates with my pipefishes—there are many different types of aquarium fish that theoretically fit in well with pipefishes, but such combinations seldom last.



*Enneacampus ansorgii* is probably the best known and one of the smallest freshwater pipefishes that we know. Kept in a group, these animals are undemanding and propagate easily if enough live food is available.

### Fussy eaters

Very few fishes are as picky as freshwater pipefishes. Not only does the food have to be alive, but, depending on the species, they have also shown individual preferences. Most pipefishes prefer black mosquito larvae, glassworms (white mosquito larvae), larger *Artemia* and *Cyclops*, and small shrimps. *Daphnia* are not always readily accepted, but they are an important part of the diet for my pipefishes.

With a little patience, you can get animals that only accept one type of food to get used to other foods. To supplement you can offer more unusual food animals, such as different species of gammarids (*Gammarus* spp.), waterlice (*Asellus aquaticus*), *Mysis*, water beetle larvae, and Mayfly and stonefly larvae.

The quality of the food animals should always be as high as possible. A food animal is only nutritious when it has a full digestive system, and this is an important, if not the most important, foundation for the long-term care of freshwater pipefishes. Simply buying a bag of live glassworms or *Artemia* occasionally and pouring them into the aquarium will not work!

Purchased food animals must first be fed and en-

This green form of *Enneacampus ansorgii* moves along the bottom with the typical "sneaking" motion. Other pipefishes swim in open water.



riched with nutrients. Glassworms like to feed on newly hatched brine shrimps and *Daphnia*. I enrich *Daphnia*, *Cyclops*, *Artemia*, and black mosquito larvae with a mix of powdered food (*Chlorella*, *Spirulina*, wheat grass, barley grass, and stinging nettle powder), dried bovine blood, or "greenwater." I prefer to collect food for my pipefishes in



The parents of baby *Enneacampus ansorgii* soon discover their offspring, but do not bother them.



After the pipefishes mate, the large eggs are clearly visible in the male's abdominal pouch.



After 10 to 12 days (or a bit longer), depending on water temperature, the eggs are already well developed and hatching is imminent.

ponds or breed it in large cultures.

With a lot of effort, it may be possible to get pipefishes to accept frozen food. However, the ingredients in most frozen foods are not adequate to feed the pipefishes over the long term.

For rearing freshwater pipefishes, freshly hatched and enriched *Artemia* are usually sufficient. *Cyclops*, tank-raised *Artemia*, small *Daphnia*, and black or white mosquito larvae are later added to the diet of the growing pipefishes.

### Good water hygiene

In principle, there are no sick freshwater pipefishes; they are either healthy or dead. This usually means that

a freshwater pipefish with an open or fungus-infected wound, a large skin discoloration, or an ulcer cannot be saved. Sometimes, when a diseased pipefish continues to eat, various measures can succeed.

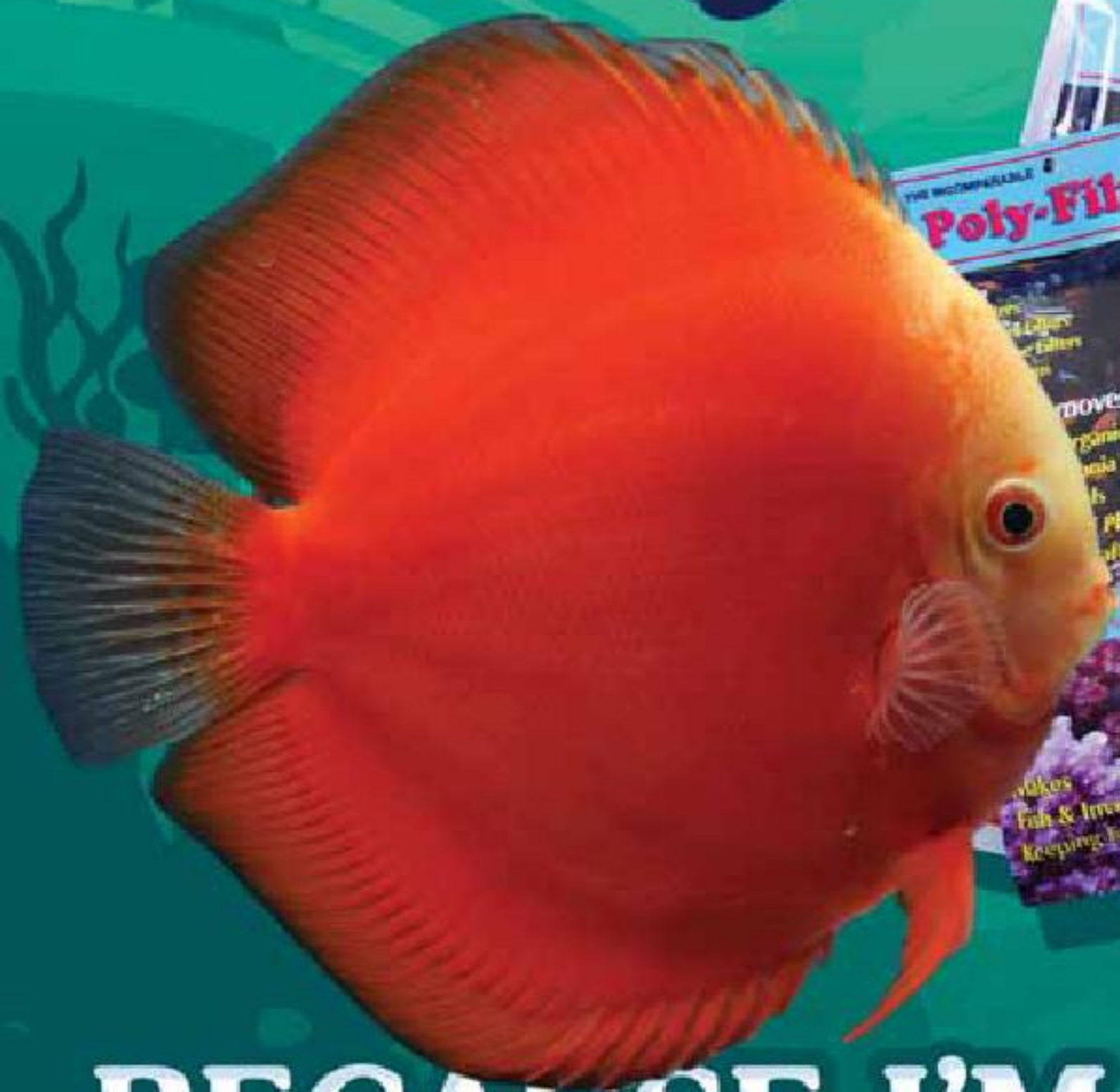
In most cases, poor water quality with lots of bacteria is the cause of the injury. Several water changes, filter cleaning, and vacuuming of the detritus should keep additional pipefishes from getting sick. You can also add some salt to the water. I prefer water softener salt, consisting of pure sodium chloride. When using marine salt mixes, the solution must be mixed and aerated for a day to dissolve various poorly soluble components.

When dosing salt, I work with a conductivity meter. For pipefish treatments, I recommend a conductivity of



Juveniles need a constant supply of the smallest live foods. The babies feed all day long without getting large bellies. This *Microphis deocata* is just one week old.

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*Ichthyocampus carce* is available only sporadically.

the aquarium. They can be destroyed with Flubenol or Panacur (Fenbendazole). These are drugs that are used in domestic animals against various worms. These treatments should only be used as a last resort. It is better not to introduce these pests in the first place, or to keep the population to a safe level through removal or baiting. Trumpet snails die from

2–6 mS/cm. Two mS/cm is about 0.4 ounce (10 g) or two teaspoons of salt per 2.5 gallon (10 L). Antibiotics such as Nifurpirinol have not produced the expected improvements. During the acclimatization of pipefishes weakened by transport, the use of a UV sterilizer that kills germs with UV light has proven useful. However, you should make sure that the water is not heated.

When I feed pond food, I regularly introduce ostracods (seed shrimp). The only cure here is targeted removal with an airline siphon and an attached thin plastic tube. The ostracods attach to the pipefishes and “nibble” on them. The pipefishes are visibly bothered by them. Sometimes the pipefishes eat the ostracods when left hungry. However, this should only be attempted with healthy pipefishes.

Planarians and *Hydra* occasionally find their way into

these treatments or suffer for weeks and then do not consume the leftover food as usual.

Freshwater shrimps are not suitable as a permanent source of food for pipefishes. They will damage the fishes by grazing on them and the pipefishes will prevent the proliferation of the shrimps by eating all the baby shrimps.

When the aquarium, feed quality and quantity, and regular care measures suit the freshwater pipefishes, they will reproduce. The raising of the young pipefishes of the aforementioned species (with the exception of *Ichthyocampus carce* and *Microphis leiaspis*) is certainly feasible, but very costly in terms of labor and time. 🐟

**Editor's note:** Hans-Georg Evers and breeder Ted Judy will cover other aspects of pipefish biology and breeding in the coming issues of AMAZONAS.

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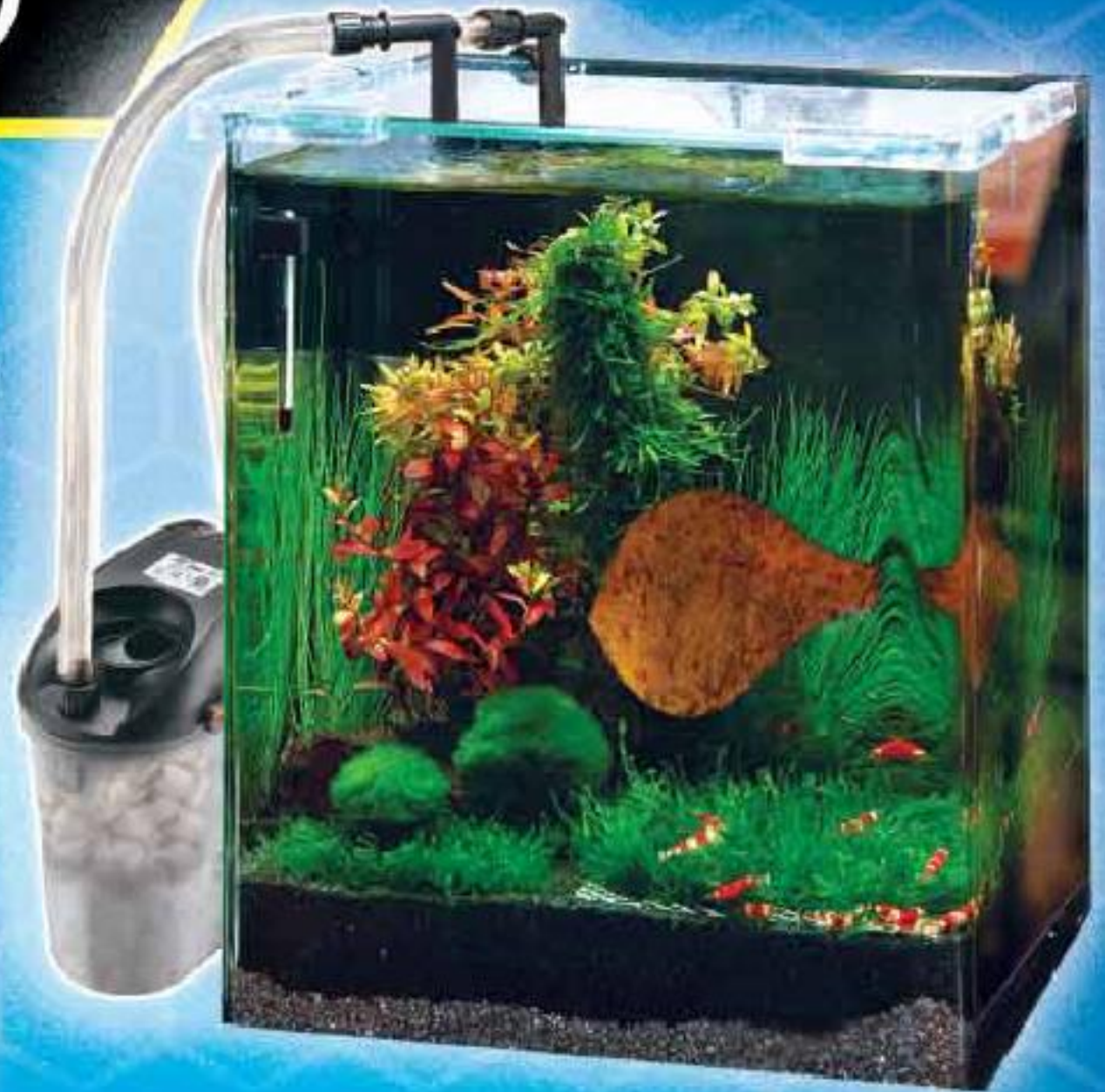
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The author's 65-gallon (245-L) brackish-water riparium, with a variety of emerged mangrove plants.

1 Red Mangrove

2 Hala Tree

3 White Mangrove

4 Black Mangrove

# The Brackish Riparium:

## 5 Mangrove Plant Selections

article & images by Devin Biggs • Mangrove swamps capture the imagination. In these mysterious habitats, where river waters mingle with the salty ocean, one can find familiar fishes of inland waters, such as *Poecilia* mollies, and majestic creatures from the wild ocean like *Carcharhinus* bull sharks. The abundant resources (water, plant nutrients, food items, sunlight) in mangrove swamps, combined with changeable conditions (water salinity, tidal surges, wind) and fierce competition, have driven the evolution of amazing plant and animal adaptations. These include fishes that crawl about on land (*Periophthalmus* spp. and other mudskippers), fishes that pass dry periods above water in hollow logs (*Kryptolebias marmoratus*, mangrove killifishes) (Taylor et al., 2008), and plants that nourish their buoyant, wave-dispersed propagules with extra energy in a manner analogous to mammalian offspring care (*Rhizophora* spp. and most other mangrove trees).

Mangrove ecosystems are valued as critical spawning and nursery habitats for many different animals and for their numerous ecological interactions with freshwater, terrestrial, and marine ecosystems. Nevertheless, like most other ecosystems along heavily populated coastlines, they are under increasing pressure from pollution, development, and natural resources extraction.

5

5

Leather Fern



Red Mangrove,  
*Rhizophora mangle*

In order to learn more about mangrove plants and animals, I have put together a 65-gallon (245-L) brackish mangrove riparium featuring plant species that have been used very little in aquarium displays. In this article I will provide an overview of the techniques I used and pass along some of the things that I learned while planning and maintaining this planted riparium fish tank. For the sake of clarification, I offer the following list of terms used in descriptions of mangrove habitats and related concepts:

- **Swamp:** a wetland habitat dominated by trees
- **Estuary:** the area in the mouth of a river that empties into the ocean and where the water level fluctuates with daily tides
- **Brackish:** refers to water that has salt content but is less salty than ocean water; often found in estuaries where seawater and river water mix together
- **Mangrove:** a tree, shrub, or other large plant that grows in a mangrove swamp; most such plants are of tropical or subtropical distribution.

Thus, a *mangrove swamp* is a tree-dominated, brackish-water wetland ecosystem that grows in an estuary or similar marine coastal area at subtropical or tropical latitudes.

### Tank setup

The tank is a standard 65-gallon (245-L), 36 X 18 X 24 inch (90 X 45 X 60 cm) glass aquarium. To create a more attractive display I removed the plastic rim from the top. This would normally be a misguided step—the plastic rim is crucial for holding this kind of aquarium together—but I do not intend to fill the tank more than half full, so it will be strong enough. A pair of 6,500 K, 39-watt HO T5 lamps on a DIY pendant fixture illuminate the enclosure and riparium planting. I installed a submersible 200 gph (757 Lph) power filter for water circulation and a 75-watt heater to maintain the water at about 75°F (24°C). I keep the tank water near the lower end of brackish salinity (around 1.005 SG) by performing frequent water changes using 2 tablespoons (0.3 L) of marine aquarium reef salt combined with each gallon (3.8 L) of conditioned tap water. (Read the online article by Ted Colleti, “Creating a Brackish Habitat Fish Aquarium,” at <http://www.fishchannel.com/setups/special/creating-a-brackish-habitat.aspx> for an overview of brackish tank methods and fish species.)

A few manzanita driftwood stumps provide extra fish habitat structure and represent the trunks of the mangrove trees and sunken logs that would be found in a mangrove swamp. Sugar-sized aragonite sand covers the bottom of the tank, representing an authentic biotope habitat and providing a pleasing visual contrast with the manzanita. The muddy bottoms of most mangrove swamps are quite dark, but I have also visited some mangrove areas with white coral aragonite sand.



Female Sheepshead Minnow, *Cyprinodon variegatus variegatus*, is a fitting choice for this biotope. It is also known as the Sheepshead Pupfish or Sheepshead Killifish.

## Fishes

Most of the plants in this aquarium grow in mangrove swamps and other habitats along the U.S. Gulf Coast in Texas, Louisiana, and Florida. With the idea of creating a loose biotope representation, I selected the following fish species that live in brackish waters in this region:

- *Poecilia latipinna*, Sailfin Molly
- *Jordanella floridae*, American Flagfish
- *Fundulus confluentus*, Marsh Killifish
- *Cyprinodon variegatus variegatus*, Sheepshead Minnow

These are all hardy animals. The *C. variegatus variegatus* are the most pugnacious and greedy fish that I have ever kept, and at first I found it difficult to adequately feed the others. But I was able to improve distribution of the food by quickly spreading it around in different areas of the tank at feeding time. I imagine that the Sailfin Mollies would have grown larger and had better coloration if I had kept them in a species-dedicated setup with less competition, but they get along with the killis well enough and look good in the setup.

While the aquarist can keep all of these species in mineral-rich fresh water, brackish water fishes usually exhibit better growth, color, and vigor when maintained in brackish water with added marine salt.

## Using riparium planters

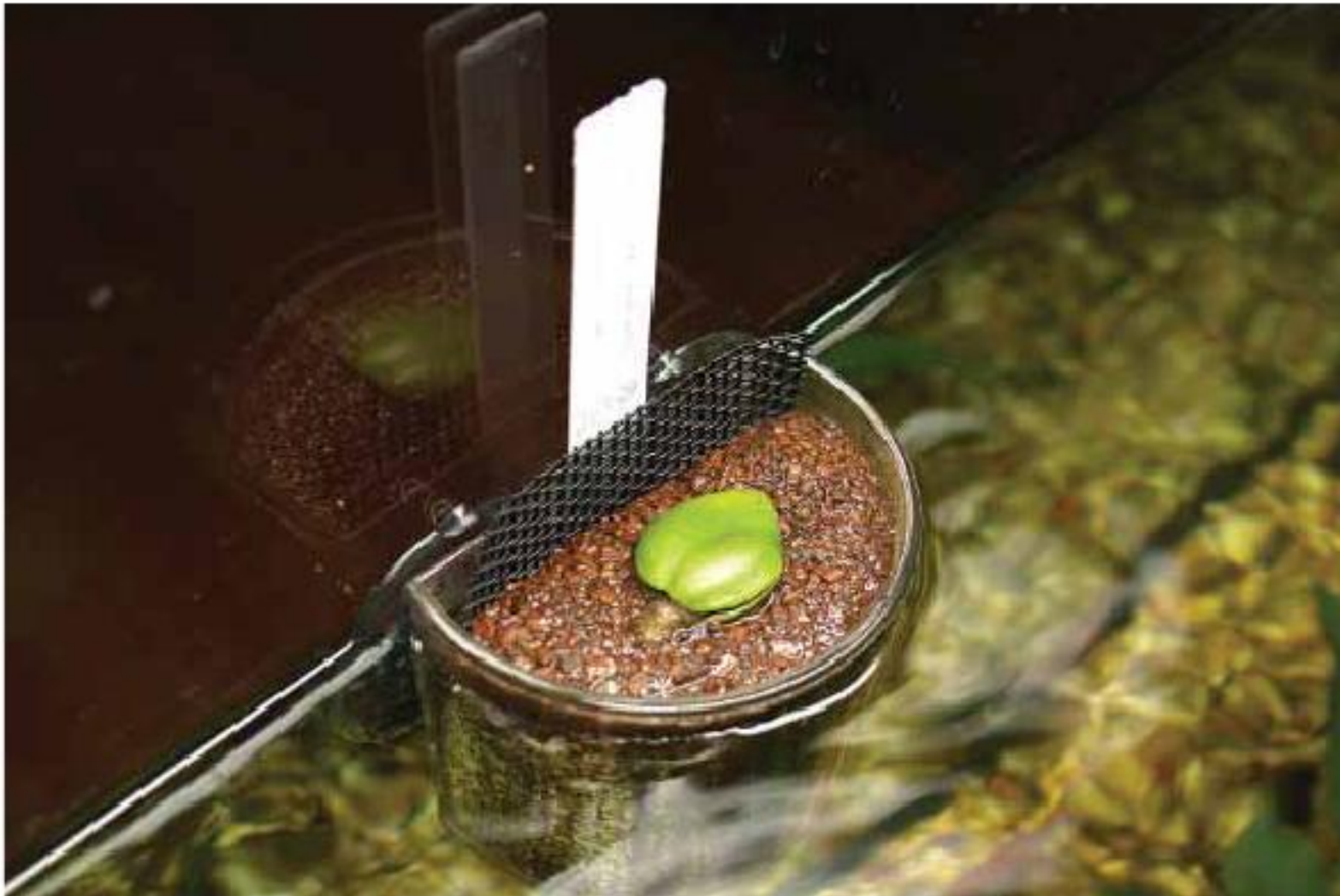
All of the mangrove plants were planted in hanging riparium planters. This was a good solution, as I was able to grow them in fairly deep (12 inches/30 cm) aquarium water while maintaining their foliage above the water's

surface. The Red Mangrove (*Rhizophora mangle*) propagules were tall enough that I could have planted them in the bottom of the enclosure, but the riparium planters are convenient for all of the plants because they permit easy repositioning and removal. Mangrove trees have strong root systems that can break the seams of a glass aquarium, but the riparium planters contain the roots safely inside. As the mangrove plants grew, their foliage and roots covered up the riparium planters to make a natural scene inside the enclosure.

Mangrove swamps slow down ocean waves and river waters, trapping and accumulating great quantities of water-suspended sediment; mangrove plants thus grow best in very rich substrates. I buried a couple of tablespoons of real topsoil in each riparium planter to nourish these hungry plants, being careful to surround the soil above and below with clay planter gravel so that it would not wash out into the aquarium water.

Salts in high concentrations are deadly for plants, but mangroves have evolved to grow with salt and they secrete the excess on their leaf surfaces. In the wild this briny film would be washed off by rain water, but in an aquarium the excess secreted salt can accumulate and damage the foliage. I spray all of the plants in this setup with reverse osmosis water several times a week to rinse away the salt residue. This step also discourages the chalk line that would otherwise develop on the aquarium glass just above the mineral-rich water.

Mangrove trees can grow to 30 feet (9 m) or taller, but of course it is impossible to fit a very large specimen



Left, Black Mangrove propagules. Left, below: The proper way to plant propagules in a moist riparium planter. Note that the propagule is not buried, but simply laid on its side on the wet substrate surface under bright light. This seedling has already begun to grow.

parent tree and continue to gain nourishment from it. Thus, the propagule that falls from the mangrove tree is, in fact, a quiescent young seedling rather than an embryonic seed. The evolution of propagules in mangrove trees is probably a response to the especially difficult conditions that the young trees confront while trying to establish themselves in brackish conditions with fluctuating water levels.

***Rhizophora mangle*, Red Mangrove:**

This tree is already popular for planting in saltwater reef tanks. When many Red Mangroves are planted in a reef refugium, they can remove nitrates and other pollutants. However, they are slow-growing plants, and tank microbial biofilters and standard aquarium water changes are probably more important for maintaining water quality. The Red Mangrove propagule is long (6–12 inches/15–30 cm) and pencil-shaped. The propagule floats like a fishing bobber, and the ocean waves can carry it away to distant

into a riparium, and a plant much taller than the rim of the enclosure would look awkward. The riparium planters hold only about 1 cup (0.24 L) of substrate, and the plant growth begins to slow as the roots fill the planter. I have also done some light pruning on some species to maintain the trees at a shorter stature.

**Plant selection**

While researching this tank concept I encountered several magazine articles and numerous Internet descriptions of brackish-water planted aquariums. There are several common aquarium plants often recommended for growing in brackish water (e.g., *Anubias* spp., *Microsorium pteropus*, *Vallisneria* spp., *Taxiphyllum* spp.), but the brackish estuary environment is less representative of their true habitats; in nature they are more typically found in fresh water. Because I wanted to create an authentic subtropical brackish estuary habitat, I chose to include the true mangrove plants rather than the more readily available aquarium plants that are merely adaptable to lightly brackish water.

Most mangrove trees reproduce via unusual structures known as *propagules*. Like most other flowering plants, mangrove trees begin life as seeds that are the products of sexual reproduction, but these seeds germinate and begin to develop while still hanging from the

shores. The shiny, leathery leaves have pointed tips and they are about 3 inches (8 cm) long.

Red Mangrove has a wide geographic distribution. It occurs in subtropical to tropical areas along both the Atlantic and Pacific coasts of North America, Central America, and South America, and its range extends east to West Africa and west to Polynesia. Of the plants that I am growing, Red Mangrove has the highest salinity tolerance, and in the wild it is the most likely to grow in seaward locations. It can even grow in full-strength marine salt water.

Wild Red Mangrove trees grow dramatic prop roots that anchor the plants in soft, unstable substrates while also serving as complex habitat structures for a myriad of underwater organisms. My Red Mangrove trees have all of their roots inside of the riparium planters, and I have not yet seen the development of any prop roots. As described in the online article “Mangroves for the Marine Aquarium” by reef aquarist Anthony Calfo (<http://www.reefkeeping.com/issues/2004-12/ac/feature>), one can encourage a Red Mangrove in the aquarium to grow prop roots by suspending the propagule in open water and subjecting it to regular water-level fluctuations.

***Avicennia germinans*, Black Mangrove:** This is one of my favorite riparium plants. The Black Mangrove propagule is large and looks much like a lima bean. Like

other mangrove trees, Black Mangroves have thick, leathery foliage that resists desiccation in salty and sunny conditions. The rounded oval leaves have a dull green sheen and are smaller than the leaves of Red Mangrove. Black Mangrove owes its common name to the dark color of the wood.

Black Mangrove has a wide distribution and occurs in most of the same areas as Red Mangrove, although its range does not extend as far west into the Pacific. This species has higher salt tolerance than some other mangrove plants, but in the wild it generally grows in more landward locations than Red Mangrove.

An especially intriguing feature of this plant is the presence of pneumatophores—erect, finger-like structures that grow from the roots. Black Mangrove pneumatophores are thought to aid in root oxygen uptake in anoxic conditions, and wild stands of Black Mangrove usually have thousands of pneumatophores protruding from the mud at low tide. I have observed my young trees starting to grow pneumatophores when they reach about 18 inches (45 cm) in height. Another nice feature of Black Mangroves is that they can tolerate light pruning, so one can maintain the trees at a smaller size in the aquarium. By contrast, pruning is often lethal for young Red Mangrove trees. Reef aquarists have used Black Mangrove with some success in full-strength marine water.

**Laguncularia racemosa, White Mangrove:** This is yet another plant that deserves more attention as a riparium possibility. I have not found any references to the aquarium culture of White Mangrove, but my plants have grown well and they lend more diversity and biotope representation to my brackish planting. The White Mangrove propagule is about 0.5 inch (1.25 cm) long and looks much like an oversized sunflower seed. A spongy husk protects the green seedling from salty water and desiccation while also providing buoyancy as the propagule floats away from the parent tree. The leaves of this plant are similar to those of other mangrove trees, but more rounded and broadest at the tip.

The natural range of White Mangrove is similar to that of Black Mangrove. It grows in more inland locations than the other mangrove trees, and in the aquarium it is suitable only for freshwater or moderately brackish conditions. The White Mangrove seedling is substantially smaller than those of the Black and Red Mangroves, so it demands a bit more nurturing after planting to establish. Like Black Mangrove, White Mangrove can withstand light pruning.

**Pandanus tectorius, Hala Tree:** This striking plant is a characteristic denizen of beaches in the tropical Pacific. The seed—Hala Tree does not grow from a propagule—looks like a very big kernel of corn and is enclosed in a fibrous, buoyant husk similar to that of a coconut. The foliage of *P. tectorius*, like that of other pandans, has spiny leaf margins and unfurls with a characteristic spiral growth habit. The base of the plant is supported by imposing, spiny prop roots that grow taller and thicker to support the tree as it grows in height and bulk. A viewer paying close attention to many of the scenes in the TV show *Lost* (filmed largely on O'ahu, Hawaii) would have noticed the characteristic foliage and prop roots of mature Hala Trees growing in locations around the beach and nearby valleys.

Hala Tree belongs to the unusual monocot plant family



White Mangrove, *Laguncularia racemosa*. Using pots or riparium planters helps moderate the normally rampant growth of mangrove trees.



Leather Fern, *Acrostichum danaeifolium*, in a riparium planter that can be attached to the back wall of the aquarium.

Pandanaceae. I have a collection of potted and riparium *Pandanus* species, and I wrote about them in some detail in a previous *AMAZONAS* article (Biggs, 2013) while describing the culture of the dwarf species *P. pygmaeus* (Dwarf Pandanus).

Although it is not a true mangrove plant, *P. tectorius* is salt-tolerant and, like most other *Pandanus* species, it can thrive in very wet soil or shallow water. Wild Hala Trees might be found on beach sand dunes or along the margins of lagoons, rivers, and mangrove swamps. A handsome and easy-to-grow small tree, it is sometimes planted as a landscape plant in suitable environments. The natural range of the Hala Tree extends from tropical coastal areas of the Pacific Ocean through much of Polynesia to Malesia and Australia.

Riparium culture of *P. tectorius* is very easy. I purchased my trees just a few inches tall and with only a few leaves, but they are now quite full and about 24 inches (60 cm) tall. When they outgrow the aquarium I will transplant them into clay pots to grow as easy-care houseplants. The Hala Trees have readily grown many prop roots in the aquarium. I like the appearance of these roots and I have found their cage-like underwater structures to be favorite hiding places for fishes.

***Acrostichum danaeifolium*, Leather Fern:** I have used this robust swamp fern in several freshwater ripariums, and it has also grown well in the brackish riparium. Full-grown Leather Ferns are big plants with a decidedly prehistoric appearance, and it's easy to imagine a plant-eating dinosaur snacking on the fronds.

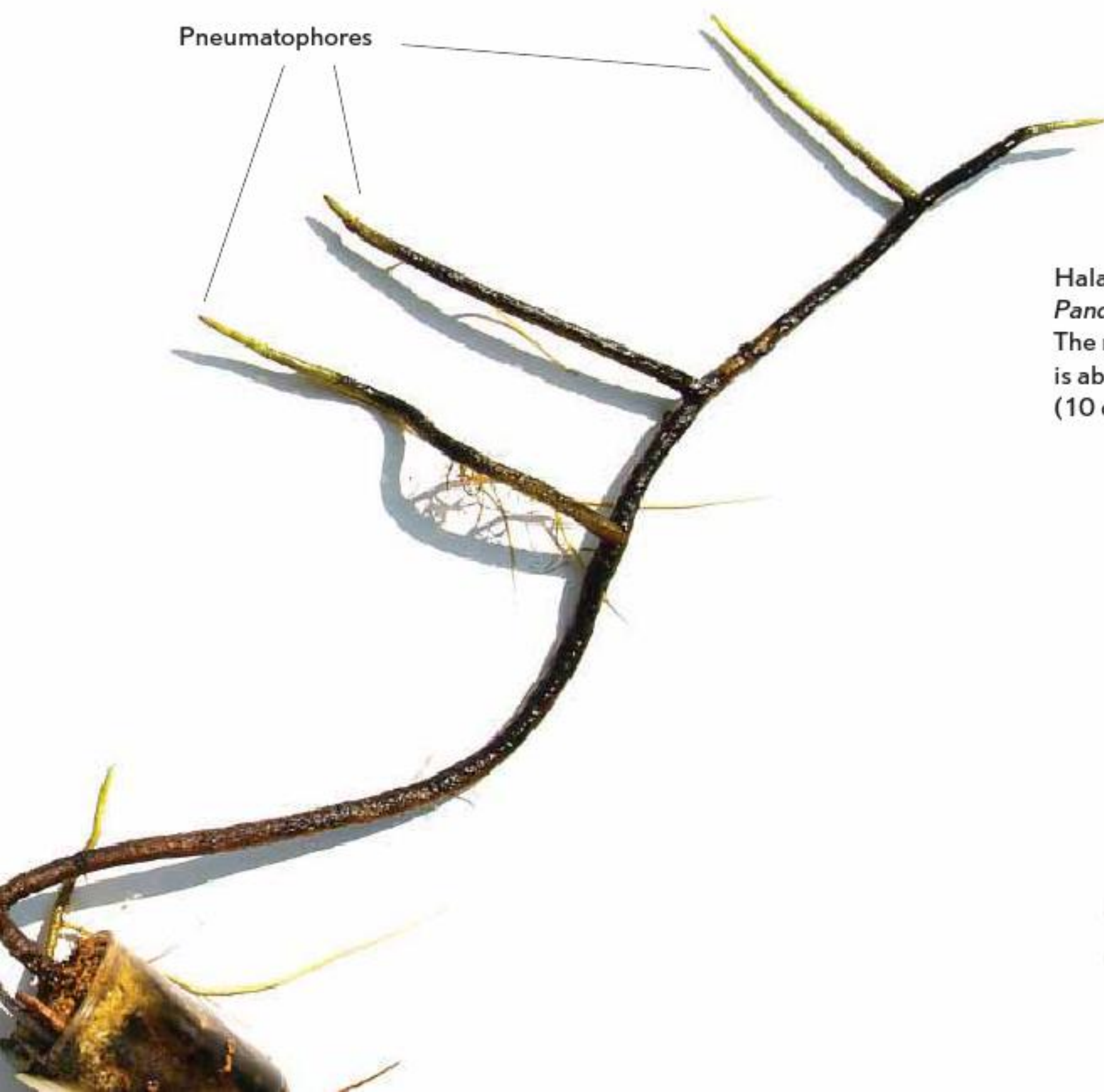


Black Mangrove, *Avicennia germinans*. This particular plant grew a long lateral root that reached all the way across the tank, as well as three vertical pneumatophores (arrows) extending to the water's surface.

The natural range of Leather Fern includes inland wetlands in Florida, the Caribbean, Central America, and northern South America. Of the plants that I have in this tank the Leather Fern is the least strongly associated with true mangrove habitats, but it sometimes grows in lightly brackish estuary water. It is most often found in freshwater inland marshes and swamps and along the margins of slow creeks. You can read a good general description of Leather Fern in the University of Florida IFAS publication "Giant Leather Fern, *Acrostichum danaeifolium*" ([http://lee.ifas.ufl.edu/Hort/GardenPubsAZ/Gian\\_Leather\\_fern\\_Acrostichum\\_danaeifolium.pdf](http://lee.ifas.ufl.edu/Hort/GardenPubsAZ/Gian_Leather_fern_Acrostichum_danaeifolium.pdf)).

The similar Golden Leather Fern (*Acrostichum aureum*) also grows wild in Florida (although its range is restricted to a few southern counties), and it is a true salt-tolerant mangrove plant. Golden Leather Fern is listed as a State Threatened Species in Florida and I have never seen it available for sale. A third *Acrostichum* species, *A. speciosum*, shares the same general appearance and occurs in tropical areas of Southeast Asia, Australia, and Malesia. *A. danaeifolium* is fairly easy to find and can thus function well as a "stand-in" riparium plant for biotope representations of these areas.

Leather Fern is a vigorous and easy-to-grow riparium plant. Wild Leather Ferns can reach a height of 12 feet (4 m), but the limited rooting volume in the riparium planters slows them down and my plants have grown to only about 20 inches (50 cm) in height. As the Leather Fern plant matures, little offsets grow around the base and these can be divided away to start new plants.



Hala Tree,  
*Pandanus tectorius*.  
The riparium planter  
is about 4 inches  
(10 cm) tall.



## Finding and starting mangrove plants

All of the species described in this article can be sourced in the United States. Because of their ecological importance it is unlawful to collect mangrove trees, even small saplings, from the wild, but it is apparently legal to collect unsprouted propagules in most areas. If you travel to Florida or coastal areas of Texas or Louisiana you might be able to find your own propagules (be sure to check local laws); you could also trade with a friend who has access. Red Mangrove (*R. mangle*) is already pretty common in the aquarium trade and is usually merchandised for use as a reef tank refugium plant, so you might find it at a local fish store. White Mangrove (*L. racemosa*) and Black Mangrove (*A. germinans*) occasionally appear for sale in various online stores. All three mangrove tree species produce most of their mature propagules in the autumn. Red Mangrove propagules are large and can be stored for months, and you might be able to find them for sale through most of the year; White and Black Mangrove propagules have a shorter shelf life and are available to collect or purchase during the fall and early winter months.

Mangrove propagules might sprout best after soaking for a period of time in brackish or salty water. This treatment simulates the wave-borne water dispersal period that happens in nature. Most of the propagules that I have acquired looked as though they had already spent some time rolling around on the beach or floating in the water, and they broke dormancy and sprouted readily, but if you have very fresh propagules you might wish to perform this saltwater soak. See the web page “Reproductive Strategies of Mangroves” (<http://www.nhmi.org/mangroves/rep.htm>) to read recommendations for treating the propagules of each species.

You should plant Red Mangrove propagules with the fatter end—where the roots will sprout—buried 2.5 inches (8 cm) in the substrate. Although they look like large seeds, the propagules of White and Black Mangrove should not be buried under the substrate like seeds, because the young plants will not be strong enough to push their way to the surface. You should instead simply place the propagules on their sides on very wet substrate. When roots start to form you can slightly bury the root ends of the propagules in the substrate. All propagules will sprout best with good lighting and warm temperatures (75–80°F/24–27°C).

Leather Fern (*A. danaeifolium*) is most often sold as a wet area landscaping plant in Florida. Gardeners also grow it as a seasonal potted pond plant, and in the springtime you might find it for sale along with other pond plants. Leather Fern suffers from transplanting, so it is important to repot new specimens right away and give them good lighting so that they can reestablish.

It is more difficult to find Hala Tree (*P. tectorius*). I purchased my small plants online from a nursery in Hawaii. I have seen the seeds for sale, but Hala Tree seeds

lose viability quickly after falling from the parent tree and they are difficult to germinate, so it is preferable to purchase this plant as a rooted seedling.

Even brackish-adaptable plants can be harmed by rapid changes in salinity. If you are starting out with unsprouted mangrove propagules, the young plants should grow well in whatever water salinity you start them in, provided that it is within the acceptable range for the species. If you wish to move the plants or otherwise alter the salinity you should gradually acclimate the plants with slowly increasing or decreasing salinity. You should assume that Hala Tree seedlings and Leather Fern plants have been started in fresh water or regular soil, so these plants should also be gradually acclimated if you want to grow them in riparium planters in lightly brackish water.

## Looking ahead

True mangrove plants offer compelling new options for growing as riparium subjects. While aquarists already keep common “brackish adaptable” freshwater plants in brackish setups, the mangrove trees and other associated plants are specifically adapted to grow in brackish waters and they create a much more authentic representation of the mangrove swamp habitat. They are also visually and scientifically compelling in their own right. A planted mangrove riparium might additionally provide special habitat features for the fishes and other animals that have evolved with these plants. These include low branches for *Periophthalmus* mudskippers to climb on, twigs from which *Toxotes* archerfish can shoot down insect prey items, and broad, open water surfaces for *Anableps* four-eyed fishes to ply.

I look forward to continued experimentation with mangrove plants, and I have my eye on a few other promising species that I might be able to find for sale, such as Buttonwood (*Conocarpus erectus*), Yautia Madera (*Montrichardia arborescens*), and Nipa Palm (*Nypa fruticans*). I like my Gulf Coast killifishes very much, but I might consider trading them for brackish estuary fishes from other regions that I can keep in new iterations of this mangrove riparium planting. 🐟

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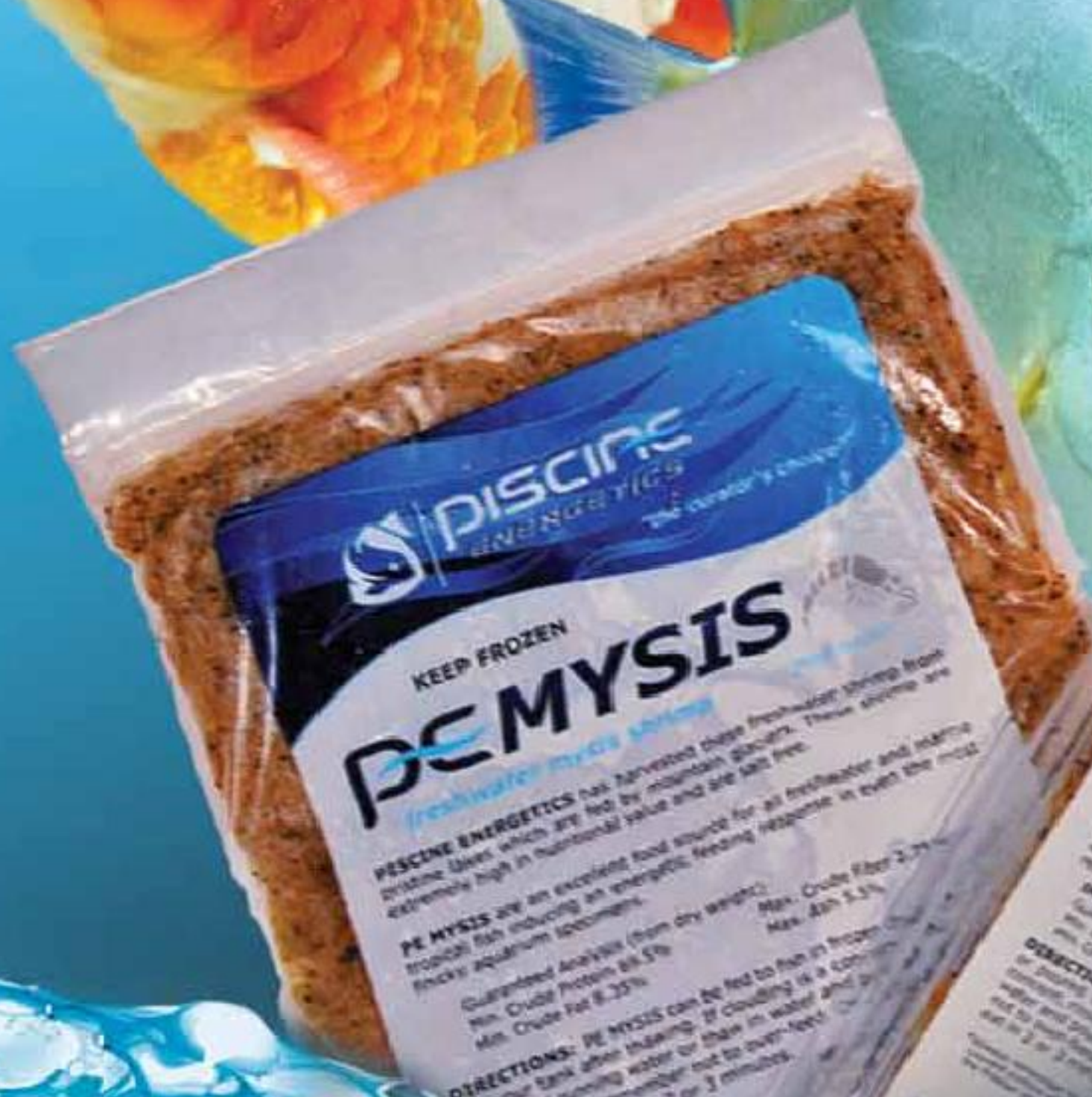
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## Pencilfishes familiar and rare: *Nannostomus* species



by Marc Puigcerver & Àngel Cánovas; images by Àngel Cánovas • Many aquarists are partial to the pencilfishes of the genus *Nannostomus* because they are suitable for small and nano community aquariums. These peaceful and sociable fishes are distinguished by magnificent colors and interesting behaviors. In recent years, several new species of the genus have been described and imported, and additional *Nannostomus* are likely to be discovered in the future.

With the exception of *Nannostomus espeii*, most *Nannostomus* species sport bright longitudinal stripes and sleek bodies, leading to the name “pencilfish.” Some pencilfishes are noted for swimming tail-down or vertically, a trait most noticeable in *N. eques* and *N. unifasciatus*.

The genus *Nannostomus* is distributed from British Guiana via Suriname, French Guiana, and the Brazilian, Peruvian, Bolivian, Colombian, and Venezuelan Amazon basin to the Venezuelan Orinoco basin. Nineteen species have been described, but fewer than ten are regularly available in the trade. The best-known species are *N. beckfordi*, *N. harrisoni*, *N. marginatus*, and *N. trifasciatus*. To these species, four more were added in the last de-

cade: *Nannostomus nitidus*, *N. anduzei*, *N. mortenthaleri*, and *N. rubrocaudatus*. Given their irregular distribution in the wild and their low population densities, it is more than probable that in remote areas even more species will be found.

### Small mouths

The various pencilfishes are generally peaceful, but also a little shy. Because of their small size, a 15-gallon (60-L) aquarium is sufficient for most species. The shy animals definitely need a densely planted habitat in which they can hide. Nevertheless, we should also offer plenty of swimming space. The rest of the tankscape depends on the taste of the aquarist. The pencilfishes are less shy if they are kept in



Left: Displaying male *Nannostomus beckfordi*, the Golden Pencilfish.

Above: A true classic: the Hockeystick, Diptail, or Brown Pencilfish, *Nannostomus eques*.

Below: The Shining Pencilfish, *Nannostomus nitidus*, is one of the more elongated species and is easily overlooked in the store.



groups of more than 10 individuals per species.

The water should be 75–77°F (24–25°C) and slightly acidic (ideal pH is ~6.5). A good filter is important to eliminate suspended particles in the water. We also recommend that the filter contain some peat, which promotes the well-being of the fishes, according to Bydžovský (1998). Regular water changes are important. The light intensity should be high, but there are exceptions. For example, *N. nitidus* should be maintained in rather dim light.

The food for pencilfishes must be very small. They should regularly get live or frozen food that matches the size of their mouths: *Cyclops*, *Daphnia*, bloodworms, and the like. They also accept dry food, but it should not be a

staple, particularly not for more sensitive species such as *N. espei* and *N. trifasciatus*. If pencilfishes are kept with other species, one must make sure that the other fishes are not faster than the pencilfishes and eat up all the food. The ideal partners are armored catfishes (Cory cats) and Neon Tetras. Small cichlids of the genus *Apistogramma* may also be suitable.

If the fish feel comfortable, you may observe that pairs form over time. The males defend a territory for their partners. If the female is gravid, you can quickly move the pair into a breeding tank. For most species, the breeding tank does not have to be very large. Ten gallons (40 liters) with a hardness of less than 3°dGH, a thin layer of peat as substrate, and a few bunches of plants are enough.

In the following overview of the species, we particularly detail three newer and less-well-known pencilfishes: *N. nitidus*, *N. mortenthaleri*, and *N. anduzei*.

### ***Nannostomus nitidus***

The Shining Pencilfish, *Nannostomus nitidus*, comes from the Rio Capim, a small river in the Brazilian state of Pará. It measures 1.4 inches (3.5 cm) standard length (without caudal fin) and 1.8 inches (4.5 cm) total length (see the photo on the previous page). However, at night it shows a different color with diagonal stripes, like many other pencilfishes. It has an adipose fin, which not all pencilfishes have, and 23–25 scales on the lateral line. One can distinguish the males from the females by the thickening of some anal fin rays, their red coloration, which continues into the tail, and their larger size.

The similar *N. digrammus* differs from *N. nitidus* in that the dark longitudinal line does not extend into the caudal fin (Glaser, 2000). *Nannostomus digrammus* also has more anal fin rays than *N. nitidus*.

Described by Weitzman in 1978, *N. nitidus* was first noticed in Europe by Hoffmann as imported by-catch of *N. beckfordi* in 1985. In 1993, the same author described the breeding of *N. nitidus* in the aquarium.

Like the other pencilfishes, this species is peaceful, shy, and sociable. It is well suited for a community tank. It prefers a tank of at least 15 gallons (60 L), shaded with floating plants such as *Ceratopteris* and *Riccia*. In addition, the plants should create retreats, although there

should also be plenty of swimming space. The water should have the following values: 75–82°F (24–28°C), pH 5.5–6.5, and hardness 5–15°dGH.

The diet should mainly consist of small live and frozen foods, but the animals will also feed on flakes. As for breeding, the recommendations above for the genus also apply here.

### ***Nannostomus mortenthaleri***

The Coral Red Pencilfish, *Nannostomus mortenthaleri* (1.6 inches/4 cm total length), comes from the Rio Nanay basin near Alvarenga, 81 miles (130 km) west of Iquitos in northern Peru. The species was discovered and exported by Martin Mortenthaler in March 2000 and was soon exported to the United States and Europe. The Coral Red Pencilfish was bred in the aquarium for the first time in late 2000 or early 2001 by Friedrich (Paepke & Arendt, 2001).

This species belongs to the higher-bodied pencilfishes. The animals have no adipose fin and the lateral line covers 19–22 scales. The markings consist of three dark, well-defined longitudinal stripes, and adult males show a pronounced red. The pattern resembles *N. trifasciatus*, but *N. mortenthaleri* is not as slender. It is similar to *N. marginatus* and was originally even considered a subspecies, but there are significant differences in the color pattern. The males of *N. mortenthaleri* are bright red between the middle and upper longitudinal stripes, but that depends on the social status of the animal. *Nannostomus marginatus* is missing these red markings and the animals lack the pronounced sexual dichromatism. In addition, the markings on the dorsal, ventral, and anal fins are different.

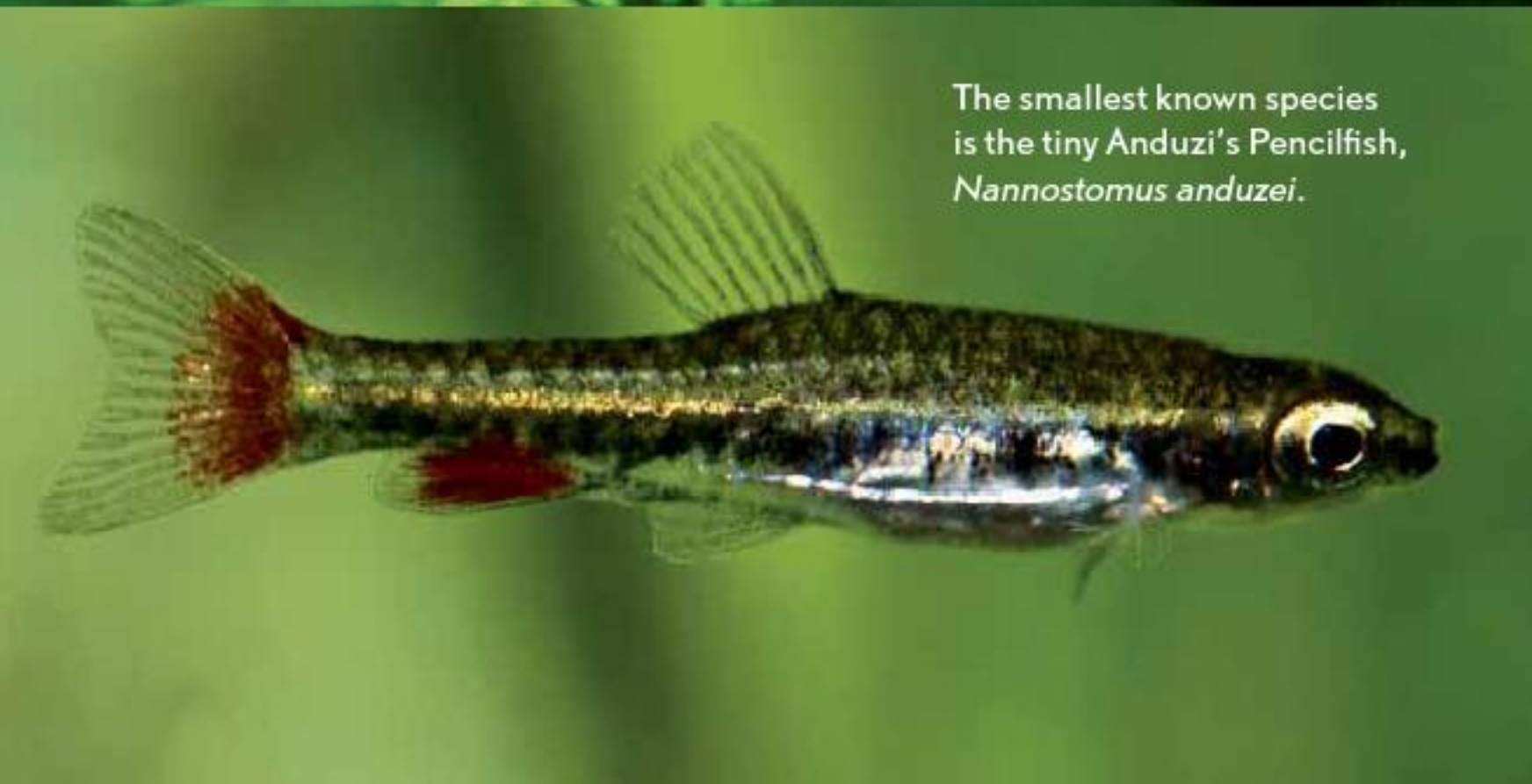
The peaceful Coral Red Pencilfish is ideal for a community aquarium. However, the males are a little more aggressive toward conspecifics and other pencilfishes during the breeding season. Dwarf cichlids of the genus *Apistogramma* make perfect tankmates.

*Nannostomus mortenthaleri* requires an aquarium of at least 15 gallons (60 L), but the intraspecific behavior of a group of 10 or 20 animals can be seen much more easily in a larger tank. The aquarium should be densely planted but should have free space for swimming. The temperature should be 75–82°F (24–28°C), the pH 6.6–6.9, and the hardness 1–12°dGH. These animals are very sensitive to polluted water, so a partial water change at least every other week is a must.

These fish are omnivores with micro-carnivore tendencies. The focus should be



Male *Nannostomus mortenthaleri*, the Coral Red Pencilfish



The smallest known species is the tiny Anduzi's Pencilfish, *Nannostomus anduzei*.



The One-Lined Pencilfish, *Nannostomus unifasciatus*, is most beautiful in a group.



The Blackstripe Pencilfish, *Nannostomus harrisoni*, is rarely found in stores.



For years, *Nannostomus espei*, the Barred or Espe's Pencilfish from Guyana was difficult to obtain. It is still an expensive rarity.

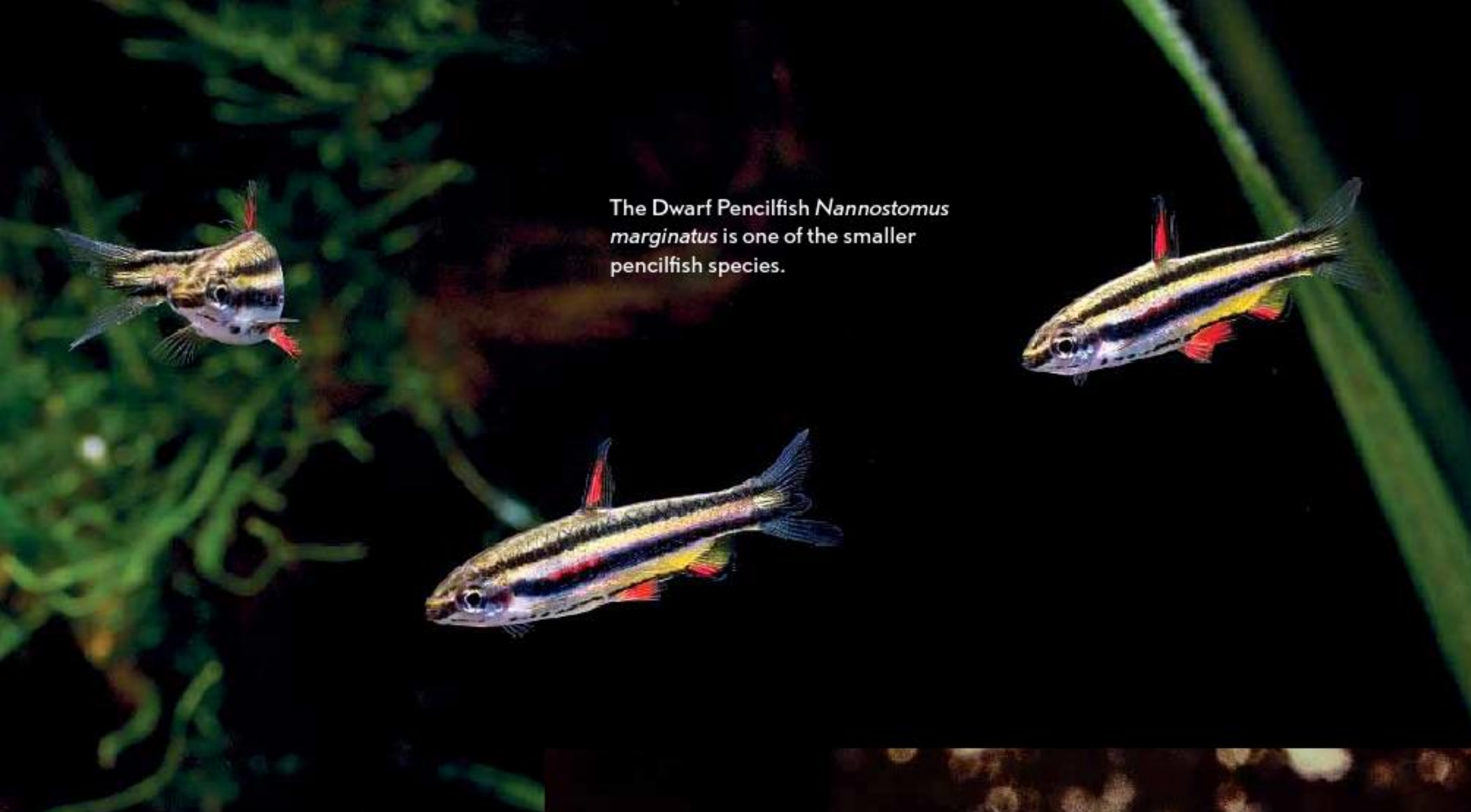
on various live foods and should reflect the small size of the mouth. However, they will also accept flake food.

The species is only moderately productive and averages 20 large eggs per spawn. Evidently, the female is the more active animal during mating. Her eggs are deposited in the calmer areas of the aquarium and quickly fertilized by the male. At this point the parents should be removed from the aquarium before they are all over the spawn.

When the yolk sac is gone, the fry need to be fed with rotifers until they can cope with *Artemia* nauplii.

#### ***Nannostomus anduzei***

*Nannostomus anduzei* is the smallest pencilfish, measuring only 0.8 inch (2 cm) total length. It is often imported along with the Green Neon Tetra, *Paracheirodon simulans*. The species originates from a lagoon located about



The Dwarf Pencilfish *Nannostomus marginatus* is one of the smaller pencilfish species.



There are various geographical forms of *Nannostomus trifasciatus*, the Three-Lined Pencilfish.

9 miles (15 km) north of Puerto Ayacucho in the Orinoco basin, and there is also a population in the Ereré River in northern Brazil. One can distinguish the two populations by the size of the anal fin.

*Nannostomus anduzei* is a gregarious species, shy and peaceful but robust. It is very suitable for beginners if they can provide the animals with an aquarium of 3–10 gallons (10–30 L) and good filtration with a large amount of peat.

The fish feel comfortable when they are kept in a small group of 6–12 animals. The aquarium should be planted densely with Java Moss and *Ceratopteris*. The temperature should be 81–86°F (27–30°C), the pH 5.0–7.1, and the hardness 2–10°dGH.

Tiny planktonic organisms, small Grindal worms, and *Artemia* nauplii fit into the small mouths of these animals. Occasionally, you can also offer some dry food.

If the conditions are appropriate, the fish spawn spontaneously in the aquarium. Then you can watch the intricate mating display, but the mating itself takes place hidden in the plants. The best way to maintain a group is to have more females than males. To encourage spawning, feed the fish with plenty of *Artemia* nauplii and perform water changes every other day. When the animals have spawned, you should remove them from the aquarium.

The larvae hatch after about three days. After they have absorbed the yolk sac, they can be fed with Liquifry. After the second week, they will accept *Artemia* nauplii.

### *Nannostomus beckfordi*

The Golden Pencilfish, *Nannostomus beckfordi*, comes from the river basins of Guyana, the Rio Negro, and the lower areas of the Amazon basin. This fish attains about 2.6 inches (6.5 cm) in total length. The females are slightly fuller than the slender, more colorful males, whose pelvic fins have white margins. Together with *N. eques* and *N. unifasciatus*, this is the longest-known pencilfish in the aquarium trade.

This calm and peaceful species, although quite shy, is sociable. The groups are hierarchical and at certain times the males defend small territories as *N. mortenthaleri* do. *Nannostomus beckfordi* prefers densely planted aquariums with dark sand as a substrate, little water movement, and peat in the filter. The temperature should be 72–86°F (22–30°C), the pH 6.0–7.5, and the hardness 4–20°dGH.

These omnivores accept almost any food—live, frozen, freeze-dried, or dry. However, note what has been written above about small, live foods, which are clearly preferred.

### *Nannostomus eques*

The Diptail or Hockeystick Pencilfish, *Nannostomus eques*, lives in Guyana and the middle and upper Peruvian Amazon. It reaches up to 2.4 inches (6 cm) total length. Together with *Nannostomus unifasciatus*, it was one of the first imported pencilfish species. These two species differ from the other species in the genus in body shape and behavior. For this reason, they were once assigned to a separate genus, *Poecilobrycon*.

The males are more colorful than the females and their pelvic fins have white margins. In addition, the caudal fin has red spots and the first anal fin rays are elongated. In contrast, the females are plumper, especially during the spawning period. The peaceful fish are very active and sociable and stay mainly in the upper layers of the aquarium, where they “stand” in the water at an angle of 45–60°. They are suitable for a community tank with peaceful and calm fishes, although a species aquarium is even better. The temperature should be 72–82°F (22–28°C), the pH 6–7.5, and the hardness 3–10°dGH.

This omnivorous fish accepts any type of live or processed food. Ideal are *Cyclops*, Grindal worms, chopped *Tubifex*, and flake food. However, these fish do not take up food from the bottom of the aquarium, so some Cory



The Purple Pencilfish, *Nannostomus rubrocaudatus*, was described just a few years ago.

cats should be kept with them. You should only use robust aquarium plants, since *N. eques* nibbles on tender leaves and shoots.

### *Nannostomus espei*

The Espe's or Barred Pencilfish, *Nannostomus espei*, reaches a total length of about 2 inches (5 cm) and comes from the basin of the Mazaruni River in Guyana. The fish are peaceful and sociable. The males have an intense golden-colored band on the body and the anal fin is more pronounced, with the first rays weakly pigmented. On the other hand, the females are chubbier. The animals stay mainly near the water's surface and usually swim with the head facing slightly up.



The large eyes of the One-Lined Pencilfish, *Nannostomus unifasciatus*, move back and forth while the fish stays totally still in the typical tail-down position.

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The temperature should be 72–79°F (22–26°C), the pH 5.5–7.0, and the hardness 7–8°dGH. These omnivores should be fed mainly with live food (fruit flies, *Daphnia*, springtails, bloodworms, brine shrimp nauplii), but also accept frozen and flake foods.

## *Nannostomus harrisoni*

A native of British Guiana, *Nannostomus harrisoni* reaches 2.4 inches (6 cm) total length. The males do not differ significantly from the females, but are smaller and more slender and have a red anal fin.

Their calm and sociable nature is similar to that of other pencilfishes, and they should be kept in groups of 10–12 animals. The temperature should be 73–82°F (23–28°C), the pH 6.5–7.0, and the hardness 5–10°dGH.

## *Nannostomus marginatus*

The various populations of the Dwarf Pencilfish, *Nannostomus marginatus*, are widespread in the northern Amazon basin from Colombia to the Guianas. The species is slightly smaller than *N. espei* and reaches only 1.6 inches (4 cm) total length. Females are fuller, and in the spawning season you can see the eggs shining through the abdominal wall. Males are more intensely colored, especially the red spots in the dorsal, anal, and pelvic fins.

This peaceful and shy fish is sociable, swims horizontally near the surface, and loves current. The temperature should be 68–82°F (20–28°C), the pH 5.8–7.5, and the hardness 4–15°dGH. This omnivore accepts all types of high quality food: flake, live, and freeze-dried. Because the animals are mainly active at dusk, one should feed them in the evening or at night.

## *Nannostomus trifasciatus*

The various populations of the Three-Lined Pencilfish, *Nannostomus trifasciatus*, can be found from the central and lower Amazon basin to the Guianas. Various forms are currently being named according to their collection location, and it is possible that in the future some of them will be described as distinct species. The females differ significantly from the males; they are fuller and less intensely colored.

This shy, peaceful fish should be kept in groups of at least eight individuals. The temperature should be 75–82°F (24–28°C), the pH 6.5–7.0, and the hardness 5–10°dGH. Live, frozen, and dry foods are on the menu, although regular feeding of live food is important.

## *Nannostomus unifasciatus*

Originating mainly from the Colombian and Brazilian Amazon basin, the One-Lined Pencilfish, *Nannostomus unifasciatus*, is also found in some tributaries of the Amazon River in British Guiana. The animals have a total length of up to 2.6 inches (6.5 cm). The gender differences are clear: the females have a more rounded body and their anal fin is black, while the males have a red-black anal fin with a white border. The fish are peaceful and sociable and should be kept in groups of at least 10 animals. The temperature should be 77–82°F (25–28°C), the pH 6.0–6.8, and the hardness 5–10°dGH.

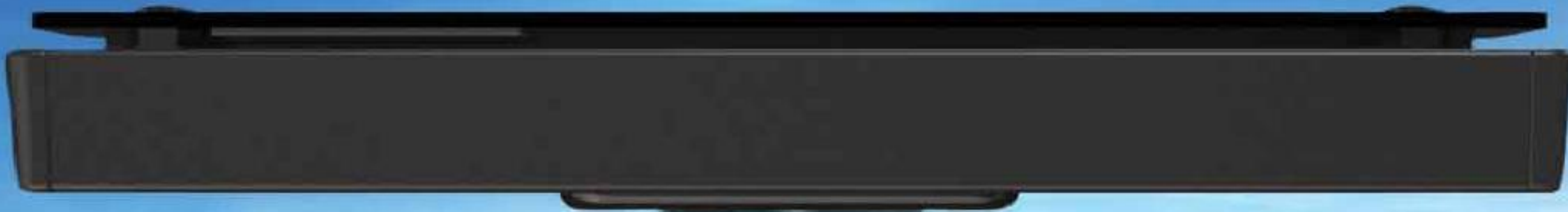
They accept most food, although one should not offer too much dry food. The animals are best fed with live food, which stays near the water's surface. 🐟

## REFERENCES

Fishbase: <http://www.fishbase.org/search.php>

Seriously Fish: <http://www.seriouslyfish.com/>

Paepke, H.-J., and K. Arendt. 2001. *Nannostomus marginatus mortenthaleri* new subspec. from Peru (Teleostei: Lebiasinidae). *Verhandl Gesell Ichthyol* 2: 143–54.



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## CALENDAR

compiled by Matt Pedersen and Ray Lucas

## OCTOBER

- 18–20 AquaFest 2013**  
**Capitol Cichlid Association, Greater Washington Aquatic Plant Association, Potomac Valley Aquarium Society**  
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<http://aquafest2013.org>
- 18–20 International Fancy Guppy Association Show, Awards Banquet, and Auction**  
**Deep South Fancy Guppy Associates**  
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[www.ifga.org](http://www.ifga.org)
- 19 Auction**  
**Greater Detroit Aquarium Society**  
<http://greaterdetroitaquariumsociety.org>
- 20 NHAS Annual Auction**  
**New Hampshire Aquarium Society**  
 Newington, NH  
<http://www.nhaquariumsociety.com>
- 26 Fall Fish & Plant Auction**  
**Greater Cincinnati Aquarium Society**  
 Cincinnati, OH  
[www.gcas.org](http://www.gcas.org)
- 26 Fall Tropical Fish Auction**  
**Grand Valley Aquarium Club**  
 Wyoming, MI  
<http://www.grandvalleyaquariumclub.org>
- 25–26 FOTAS 2013—That 70s FOTAS**  
**Federation of Texas Aquarium Societies**  
 Friendswood, TX
- 27 FOTAS 2013—Auction**  
 Houston, TX  
<http://houstonaquariumsociety.org>
- 27 EAS Fall Auction**  
**Erie Aquarium Society**  
 Erie, PA  
<http://erieaquariumsociety.com>

## NOVEMBER

- 8–10 Fall Koi Show**  
**North Florida Koi Club**  
[www.nfkc.info](http://www.nfkc.info)
- 9 Tropical Fish Auction**  
**Motor City Aquarium Society**  
 Madison Heights, MI  
[www.motorcityaquariumsociety.com](http://www.motorcityaquariumsociety.com)
- 11–13 2nd International Elasmobranch Husbandry Symposium**  
**Elasmobranch Husbandry Org**  
 Monterey, CA  
<http://elasmobranchhusbandry.org>
- 15–17 Aquatic Experience—Chicago**  
**World Pet Association**  
 Schaumburg, IL  
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- 22–24 OCA Extravaganza 2013**  
**Ohio Cichlid Association**  
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## JANUARY 2014

- 11 Annual Winter Swap Meet**  
**Grand Valley Aquarium Club**  
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<http://grandvalleyaquariumclub.org/>

## FEBRUARY 2014

- 22–23 Killifish Karnival**  
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Male *Betta apollon*, a Malaysian mouthbrooder

### *Betta apollon*

**1** | *Betta apollon* Schindler & Schmidt, 2006 was named after the Greek god Apollo, who was known for his youthful beauty. Young male *B. apollon* are likewise attractive, but by the time they are two years old these fish (and many other mouthbrooding bettas) begin to grow more corpulent. *Betta apollon* can live to be eight years old; they can reach 2 inches (5 cm) in length and become increasingly phlegmatic as they age, so it's a good idea to start with a group of young animals.

Identification of the mouthbrooding bettas from the Malay Peninsula is confusing. To simplify that somewhat, they have been divided into two species complexes: *B. pugnax* and *B. stigmosa*. *Betta apollon* and *B. ferox* are assigned to the *B. stigmosa* complex. Unlike members of the *B. pugnax* complex, these species have a well-defined ladder pattern in the unpaired fins. These three species can only be distinguished from one another by the color of the throat and the number of fin rays.

*Betta apollon* should be kept in a larger group of at least seven animals in a 15–20-gallon (60–80-L) tank. It is even better to keep a group of 20 to 30 animals in

a suitably large aquarium.

The females can be very aggressive toward each other, locking lips and dropping their lower jaws, which I had only observed in the *B. edithae* group. During these encounters, the males usually wait discreetly in the background.

*Betta apollon* should be kept in a well-structured aquarium with lots of stone structures, caves, and plants. The mountain streams of its natural habitat have 20–80  $\mu\text{S}/\text{cm}$  conductivity and slightly acidic pH values. However, they will tolerate other water parameters, even very hard and alkaline values. Similar species and populations are also found in karst waters.

As long as you perform frequent water changes and provide hearty live foods, a pair will soon form and reproduction is inevitable. Pairing takes at least 24–30 hours. The female defends the mouthbrooding male in her territory. He releases 60–80 juveniles after 14–23 days, depending on the conditions in the aquarium.

—Jens Kühne

### REFERENCE

Schindler, I. and J. Schmidt. 2006. Review of the mouthbrooding Betta (Teleostei, Osphronemidae) from Thailand, with descriptions of two new species. *Z Fischk* 8: 47–69.



*Glyptothorax callopterus*,  
an Asian buffalohead catfish

### *Glyptothorax callopterus*, buffalohead catfish

**2** | Asian catfishes are much more rare in the aquarium hobby than their South American relatives, a situation that is not likely to change. The extreme diversity of catfishes found in South America continues to interest aquarists, and new species are still being discovered.

But there are catfish genera found in Asia that are equally interesting, and some are so beautiful that they deserve a regular place in the hobby. One of these is *Glyptothorax callopterus*, a common representative of the genus *Glyptothorax* that is known as buffalohead catfishes. There are many of them on the Malay Peninsula, especially in southern Thailand. The patterns of individual populations differ from each other. *Glyptothorax callopterus* is often confused with *G. fuscus*, whose distribution is supposedly limited to eastern Thailand in the administrative districts of Chantaburi and Trat. The *Glyptothorax callopterus* population that lives near the Thai town of Betong, located on the Malayan border, has a particularly pretty pattern.

Buffalohead catfishes live in clear, unpolluted, and oxygenated rapids and, due to some anatomical adaptations, can “stick” to stones. So far, I have only found *G. callopterus* in soft water with up to 80  $\mu\text{S}/\text{cm}$  conductivity and a neutral pH. *Glyptothorax callopterus* shares the habitat with a few other rheophilic freshwater species, among them the Lizard Catfish (*Homaloptera smithi*) and other buffalohead catfish species.

It is not necessary to imitate the extreme rheophilic conditions in order to keep this fish. *Glyptothorax callopterus* seems content with normally filtered and recirculated aquarium conditions as well. It is more important to give them hearty live food. Care must be taken when choosing tankmates to make sure this initially shy species receives enough food.

After acclimatization and proper placement of decorative items, *G. callopterus* are sociable and can be observed all day. This buffalohead

catfish is also one of the smallest of its kind and easy to maintain. Its maximum total length is 3.2 inches (8 cm), and the Betong population is even smaller. The species has not yet been bred in captivity—a challenge for aquarists who like to “tinker.”

—Jens Kühne

#### REFERENCE

- Vidthayanon, C. 2004. *Handbook of Freshwater Fishes of Thailand*, Sarakadee, Bangkok, Thailand.
- Smith, H.M. 1945. *The Freshwater Fishes of Siam, or Thailand*. US Government Printing Office, Washington, DC.
- Ferraris, C.J., Jr. 2007. Checklist of catfishes, recent and fossil (Osteichthyes: Siluriformes), and catalogue of siluriform primary types. *Zootaxa* 1418: 1-628.

### *Amatitlania siquia*, Honduras “Red Point” Cichlid

**3** | In addition to the omnipresent Convict Cichlid, *Amatitlania* (formerly *Heros*) *nigrofasciata*—a great fish for cichlid beginners—there are three other species of this relatively young genus that was erected just a few years ago (Schmitter-Soto 2007). From Costa Rica, Honduras, and Nicaragua comes *Amatitlania siquia*, named after the Río Siquia on the Caribbean coast of Costa Rica.

I discovered these pretty 4-inch (10-cm) cichlids recently at Aquarium Tonndorf in Hamburg, Germany, where three pairs were preparing to breed in a large



Pair of *Amatitlania siquia*, male on the left.

aquarium. Courting males are light blue and have orange-red and metallic blue-framed fins. No wonder this species is a bit more successful in the trade compared to the other two described species, *A. kanna* and *A. coatepeque*. It is maintained and bred by many cichlid lovers.

—Hans-Georg Evers

.....  
REFERENCE

Schmitter-Soto, J.J. 2007. A systematic revision of the genus *Archocentrus* (Perciformes: Cichlidae), with the description of two new genera and six new species. *Zootaxa* 1603: 1-76.

***Hypseleotris cf. guentheri*, Rainbow Prigi**

**4** | I admit I was a bit perplexed when I first found this goby in my net. Even now, I still have my doubts as to whether it is *Hypseleotris guentheri*, a species that is well known from the northern coast of New Guinea (Allen, 1991). My friend Jeffrey Christian and I caught them in January 2013 on the northeast coast of the Vogelkop Peninsula, West Papua, near the village of Waren in Kali Waren (85 µS/cm, 78°F/25.6°C). This might be a new location for this species, because it has not previously been found that far west. We also caught a very pretty *Mogurnda* species whose identity has not yet been determined.

When I compare “our” fish with the Allen's picture (1991), I note significant differences in the coloration. Territorial males become dark, almost black, and then the attractive fin coloration gets particularly intense. Among the specimens we collected there were some very gravid females. Apparently they released their

eggs during shipping—the walls of the bags were covered with thousands of tiny eggs. Mainly because their eggs are so small, rearing them has not been successful.

—Hans-Georg Evers

.....  
REFERENCE

Allen, G.R. 1991. *Field Guide to the Freshwater Fishes of New Guinea*. Publication No. 9, Christensen Research Institute, Madang.

Thacker, C. and P.J. Unmack. 2005. Phylogeny and biogeography of the eleotrid genus *Hypseleotris* (Teleostei: Gobioidi: Eleotridae), with redescription of *H. cyprinoides*. *Rec Aust Mus* 57: 1-13.

**Malabar Snakehead, *Channa diplogramma***

**6** | *Channa micropeltes* (Cuvier in Cuvier & Valenciennes, 1831) from the Malay Peninsula is one of the largest snakehead species that we know of. *Channa diplogramma* (Day, 1865), from the southern Indian state of Kerala, was long considered a synonym of this species, and they are quite similar. Roberts listed *C. diplogramma* as a valid species in 1989, and we now know that the differences between them are quite easy to determine in live specimens.

The juveniles of *C. diplogramma* are somewhat lighter colored and show the same typical orange and black striped pattern in the first weeks of life. The coloration of semi-adult to adult specimens is quite amazing. Although flash pictures show a black and white bar pattern reminiscent of *C. micropeltes*, the ground color on the upper half of the bodies of freshly caught dominant animals is dark blue.

Even though they are very attractive, such hunks



Two males (below) and a female *Hypseleotris cf. guentheri* from Waren.



Freshly collected dark blue specimen of *Channa diplogramma*.



Juvenile pattern of the Malabar Snakehead.

### Kamaka Rainbowfish

**5** | *Melanotaenia kamaka* is definitely one of the prettiest dwarf rainbowfishes out there. It is a glowing steel blue with a dark blue upper body. I know of very few fishes that are such a bright blue, even in normal coloration. During courtship the males display a white crest on the forehead and a sparkling white dorsal fin. With a maximum size of about 3.2 inches (8 cm), this fish is quite small and the males grow rather deep-bodied. It was described from Lake Kamakawaiar (called “Kamaka” by the natives), one of the famous Triton lakes east of the Bomberai Peninsula in

are unsuitable for keeping the average aquarium—they reach at least 40 inches (1 m) in total length—and it is illegal to possess *Channa* species in the United States.

—T. Syed

#### REFERENCE

Roberts, T.R. 1989. The freshwater fishes of western Borneo (Kalimantan Barat, Indonesia), *Mem Calif Acad Sci* 14: i–xii, 1–210.

West Papua, New Guinea, and introduced to the hobby by Heiko Bleher in 1995.

This easy-to-breed species has not been a big success in the aquarium hobby so far, but it is still found in the collections of specialized breeders. Let us hope that this captive population survives and grows, as further wild imports are unlikely due to the remoteness of the Triton lakes.

—Hans-Georg Evers



Male *Melanotaenia kamaka*, the beautiful dwarf Kamaka Rainbow.



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A head-on look at the serious face of a male Rosetail Half-Moon Betta (*Betta splendens*). You can rely on two things with bettas: they are beautiful and predictable—always ready to fight either their own reflection or another betta. To get this shot, I had to pre-focus the camera on the tank, set up six external flash units, lure the fish to the front with his own reflection in a mirror, and wait until he struck a macho pose before I hit the shutter. Thanks to my friends at Segrest Farms for the beautiful subject.

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