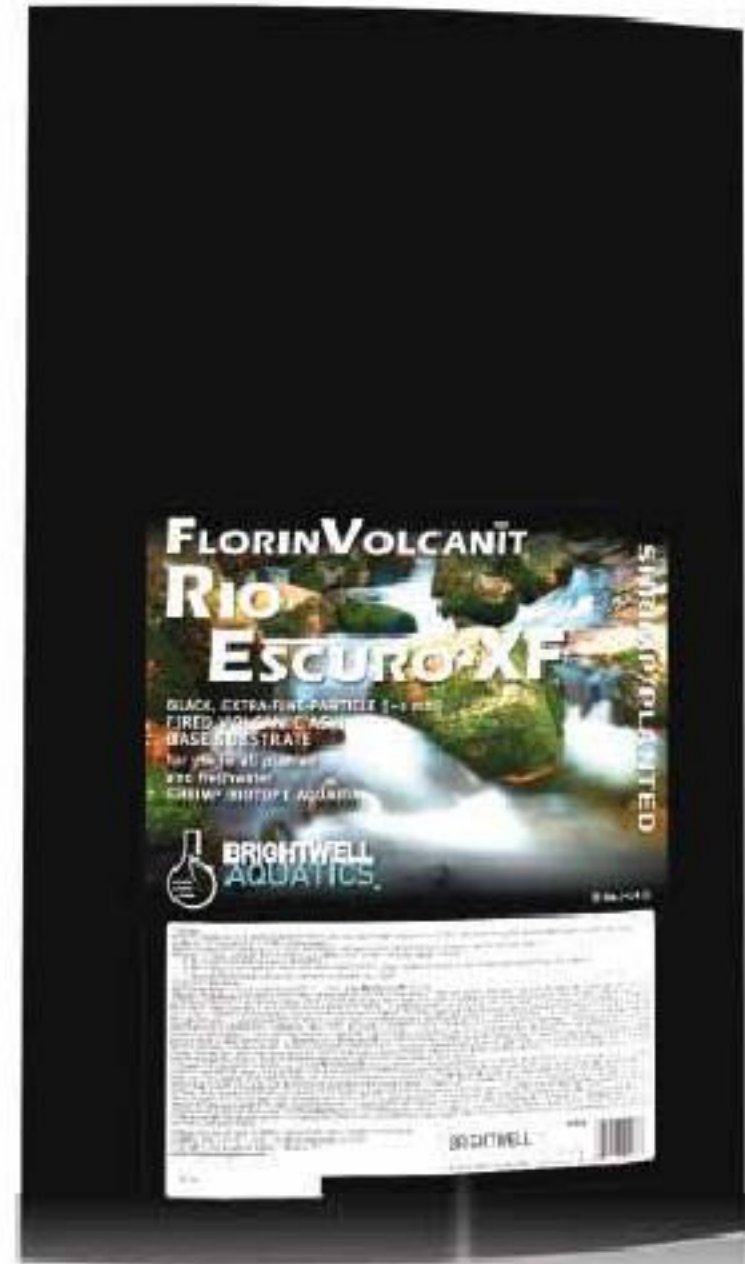
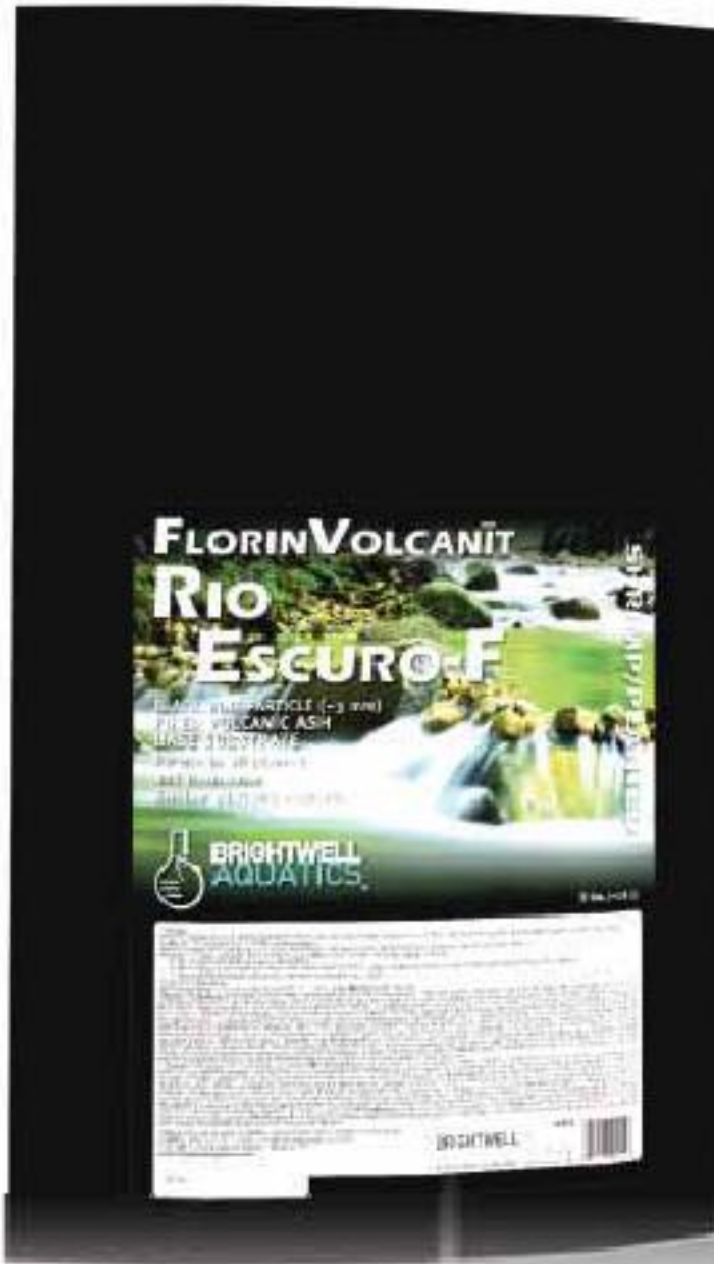




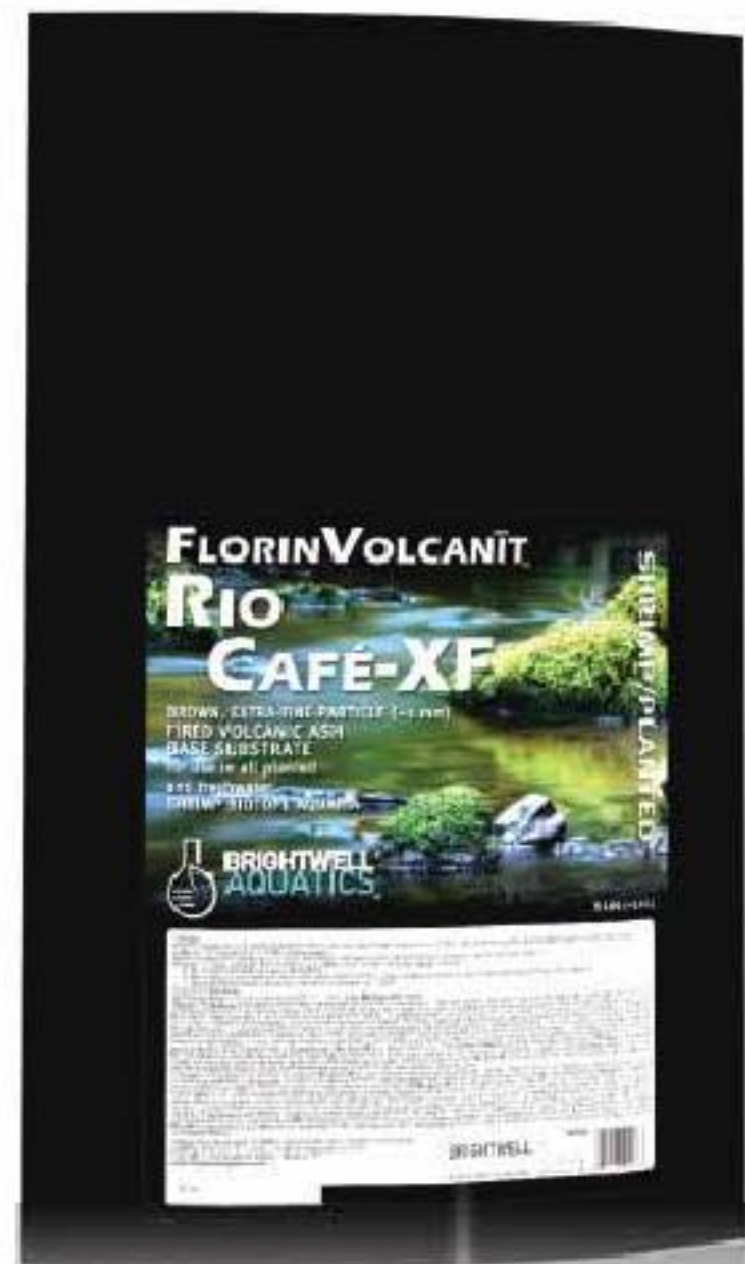
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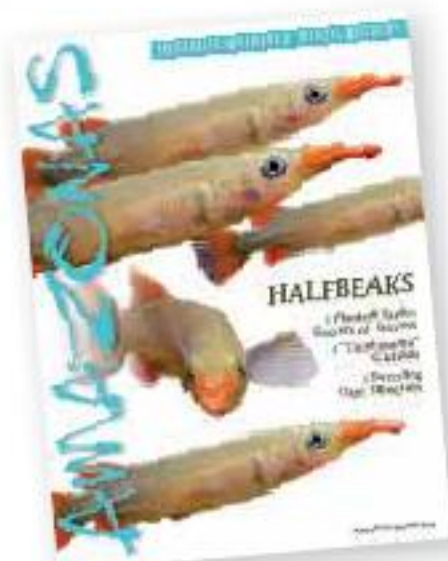
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by Morrell Devlin



## Dear Reader,

“When someone returns from a journey, he has stories to tell. That’s why I choose to take my hat and walking stick and go traveling.” So said Matthias Claudius (1740–1815). We aquarists are a traveling crowd, whether we’re visiting a jungle or a destination tropical fish shop, and we like to talk and write about our experiences. A report on a trip in search of fishes can be simple, or it can be structured almost like a scientific article.

In this issue, we have put together a few reports that will bring you closer to the habitats of our aquarium inhabitants. We try to omit predictable travelog descriptions (I was cured of this early on, when I had to endure my uncle’s long-winded slide show narrations) and boring pseudoscientific discussion. The focus is on the details—for example, this issue includes a story on Brazil’s Rio Negro that is accompanied by magnificent images of blackwater fishes. We also like to present an overview of a particular species or group and its distribution.

For years now—actually, since the birth of *AMAZONAS*—I have wanted to do a story about the quirky halfbeaks. My interest was piqued when I first visited my dream island, Sulawesi, in 2007. Since then I have returned several times, and have put together an overview of the halfbeaks of that island, something which has not been done before. It was difficult not to drift off into daydreaming during this self-assigned work. My heart and soul has gone into this article, and I confess that it might have become a bit too long!

However, not every story in this issue is about halfbeaks. There is also a great article on the hard work of professional aquarists in Canada who are breeding stunningly beautiful Tiger Rays. Readers of the English-language edition will meet two next-generation planted-aquarium fanatics, Kris Weinhold and Sumer Tuwari.

We believe that each issue of *AMAZONAS* should be just as diverse and vivid as the fishes we keep. I hope we have succeeded once again in putting together a tempting and colorful smorgasbord for you.

Bon appétit!





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# Unexplained color changes in Loricariidae



*Pseudacanthicus* sp. L273  
after the color change.

**AMAZONAS Staff Report** • Aquarists are often treated to the sight of an armored catfish undergoing a dramatic color change. This usually affects a single individual at a time and seems unconnected to anything its keeper has done. The body lightens up and eventually turns an orange or lemony color; sometimes the fish reverts to its original colors at the end of the process, which can take from several weeks to a year. The *Panaqolus* sp. LDA1/L169 specimen pictured on page 8 changed its color to orange and then back within a year. A few years later, it happened again.

The color change is developmentally regulated at the species level. For example, all *Hypostomus luteus* specimens recolor with advancing age, but each individual does so at a different pace; in *Parancistrus aurantiacus*, single specimens recolor bright yellow in nature, but not in the aquarium. In other species, the color change seems to be an individual phenomenon. Hormones might be crucial for the

initiation of this transition, and a hormonal malfunction in the individual animal would not affect the other animals in a group.

One of our readers, Daniel Konn-Vetterlein, observed a complete color change in a *Parancistrus nudiventris* within three weeks (pers. comm.). However, we have never seen a yellow specimen of this species in nature. Konn-Vetterlein noted that his fish had been



Adult Cactus Pleco, *Pseudacanthicus spinosus*, undergoing color change. The original color pattern is still recognizable.



The transformation is almost complete.



Lemon-yellow *Pseudacanthicus spinosus* in the aquarium of Heinz Trost.

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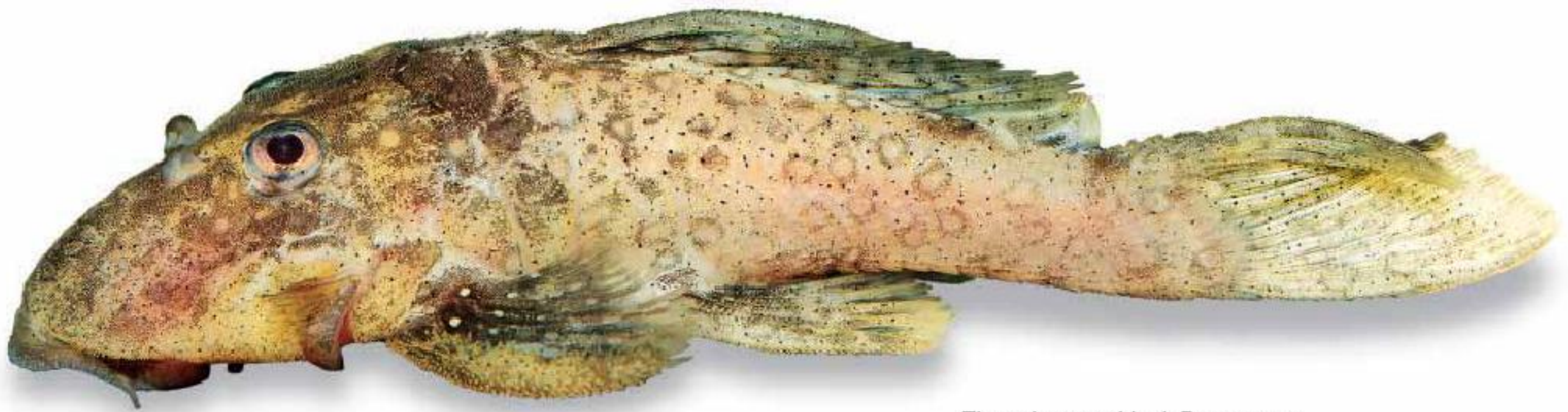
Normally colored specimen of *Panaqolus* sp. LDA1/L169.



*Panaqolus* sp. LDA1/L169, mid-change.



At several months of age, the fish is yellow with orange stripes.



This otherwise black *Parancistrus nudiventris* is slightly blurred.

given a particularly protein-rich diet prior to the process. Other catfish keepers have noticed similar color changes after changing to a high-protein diet, which is unnatural for these fish. Could this be the trigger in individual animals to switch the color via the metabolism?

AMAZONAS reader Heinz Trost sent us pictures of an adult *Pseudacanthicus spinosus* that changed from its normal gray-brown to a bright lemon yellow and then back again within a few weeks. The fish had already

made this color change several times before; the other individuals in his group remained unchanged. The color change in an adolescent *Pseudacanthicus* sp. L273 is quite spectacular, as you can see in the photos sent in by reader Markus Kaluza. If you want to see more examples, go to the highly recommended website [www.l-welse.com/reviewpost/showproduct.php/product/1832/cat/15](http://www.l-welse.com/reviewpost/showproduct.php/product/1832/cat/15), where you can see photos of various species that undergo this yellow color change. (Use Google to translate.)

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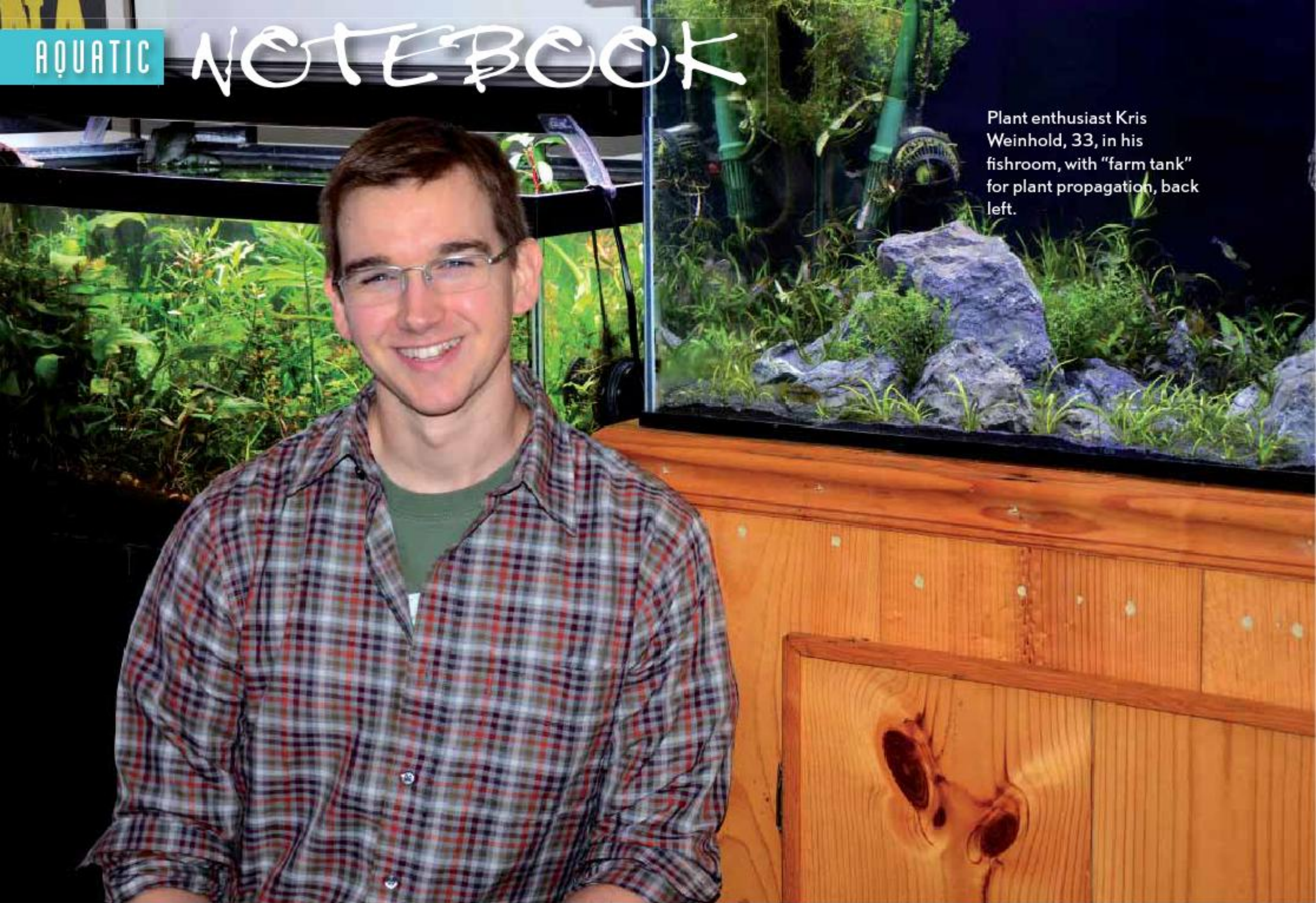


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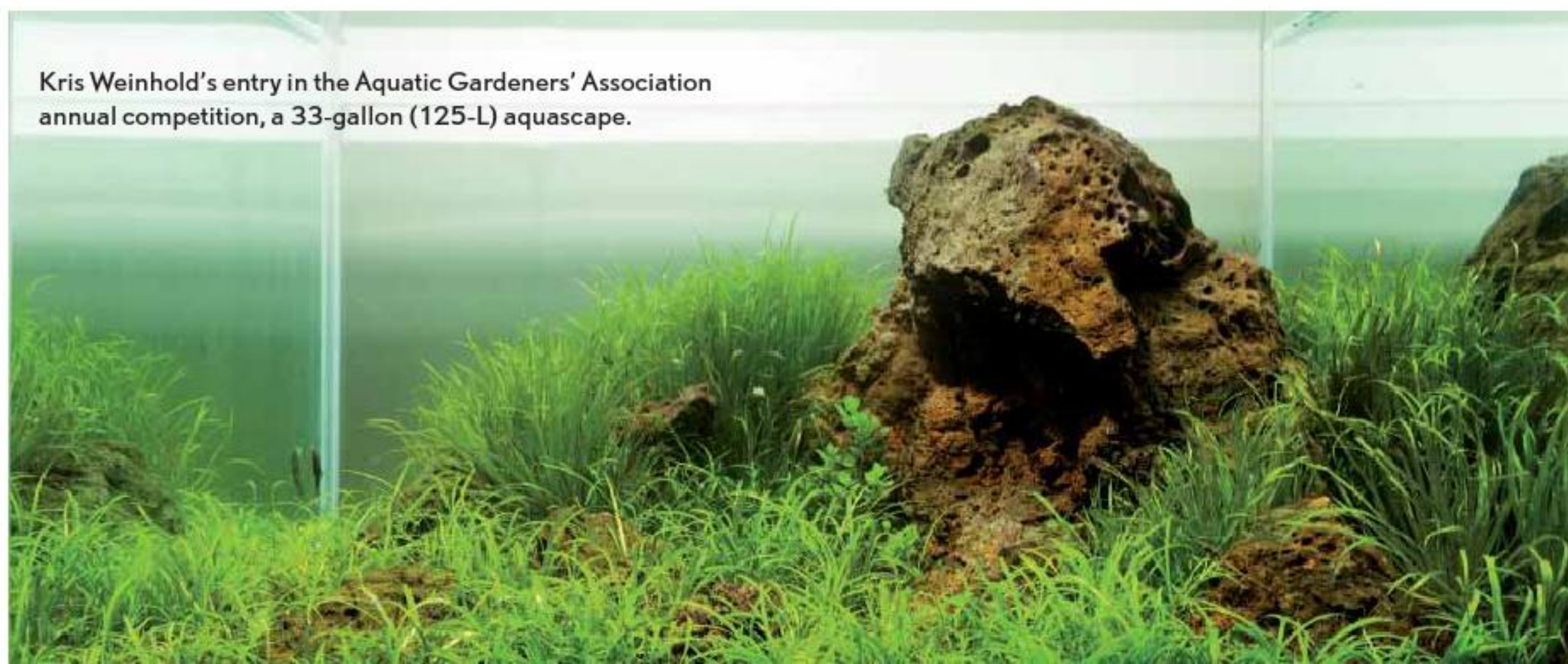


Plant enthusiast Kris Weinhold, 33, in his fishroom, with "farm tank" for plant propagation, back left.

TRAVELING THE FISH SCENE:

## Kris Weinhold, Iron Aquascaping, and planted tank open secrets

by *Rachel O'Leary* • I was sitting in an audience raptly watching an Iron Aquascaper Challenge between two aquarists, Jen Williams and Cavan Allen, and thoroughly enjoying the play-by-play commentary by Kris Weinhold. I had traveled to Herndon, Virginia, to speak at Aquafest, a convention hosted by three local aquatic clubs: the Capital Cichlid Association, the Greater Washington Aquatic Plant Association (GWAPA), and the Potomac Valley Aquarium Society.



Kris Weinhold's entry in the Aquatic Gardeners' Association annual competition, a 33-gallon (125-L) aquascape.

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A close-up photograph of a Blackbanded Sunfish in an aquarium. The fish has a light-colored body with several dark, vertical bands. It is surrounded by green artificial plants and other smaller fish, including a Black Neon with a bright yellow stripe and a red eye.


A Blackbanded Sunfish, an East Coast native growing to just 4 inches (10 cm), with Black Neons in a tank with basalt rock hardscape and a profusion of plants.

Kris was a familiar face, as we are members of some of the same clubs and have bumped into each other many times over the years. The aquascaping contest was great fun, and Kris did a terrific job narrating and educating the attendees on choices of substrates, hardscapes, and plants, layout, and lighting design. Somehow he easily held the crowd's interest while the dueling teams of aquascapers frantically worked to complete their 20-gallon high tanks within an hour.

This trip also gave me the opportunity to talk with Kris in his home fishroom and hear about his evolution as an aquarist and emerging player in the planted-tank world. He lives in Columbia, Maryland, with his wife, Lauren, and their furry friends, two dogs and two cats. By day, he uses his degree in computer science to manage a team of web developers for a medical non-profit organization. His fishroom is a bright, welcoming haven that showcases the breadth of his aquascaping talents. He has several planted display tanks as well as a "farm tank" for growing out new plants.

"I pretty much maxed out at five or six tanks, totaling about 250 gallons. Since all of my tanks are high-light with pressurized CO<sub>2</sub> and fully planted, it becomes both expensive and time-intensive to keep and maintain too many more than this. This number allows me to maintain several different aquascapes at one time, an emersed setup, and a farm tank."

Kris collects wild plants during his travels as a speaker, and he often incorporates them into his designs. The

A close-up photograph of a *Nimphaea micrantha* plant. The leaves are bright green with prominent reddish-brown veins and spots. The plant is growing in an aquarium setting.

*Nimphaea micrantha*, a West African native plant new to the aquarium world, is sometimes known as Blue Egyptian Lotus or Blue Lily.

33-gallon "Bermuda Tank" features *Ludwigia sphaerocarpa*, which he collected from the Eastern Shore of Maryland, across the Chesapeake Bay from Washington. While many aquarists focused on planted tanks consider fishes secondary to their plants, Kris is also interested in the behaviors and breeding of his fishes. Obviously, he prefers species that won't damage his plants, and many of his tanks feature interesting cichlids (*Apistogramma*, *Pelvicachromis*, and *Pterophyllum*), barbs, *Corydoras*, and loaches (*Micronemacheilus cruciatus*, the Dwarf Zebra Hovering Loach, is his favorite). He also has an interest in shrimps and nano fishes for his smaller tanks, and says that the activity and color provided by the fishes and invertebrates are integral to his overall tank designs.

A life-long aquarist, Kris first became interested in planted tanks about 10 years ago when a co-worker introduced him to Takashi Amano's book *Nature Aquarium World*. Kris was captivated and joined several online planted forums, as well as GWAPA, his local aquatic plant

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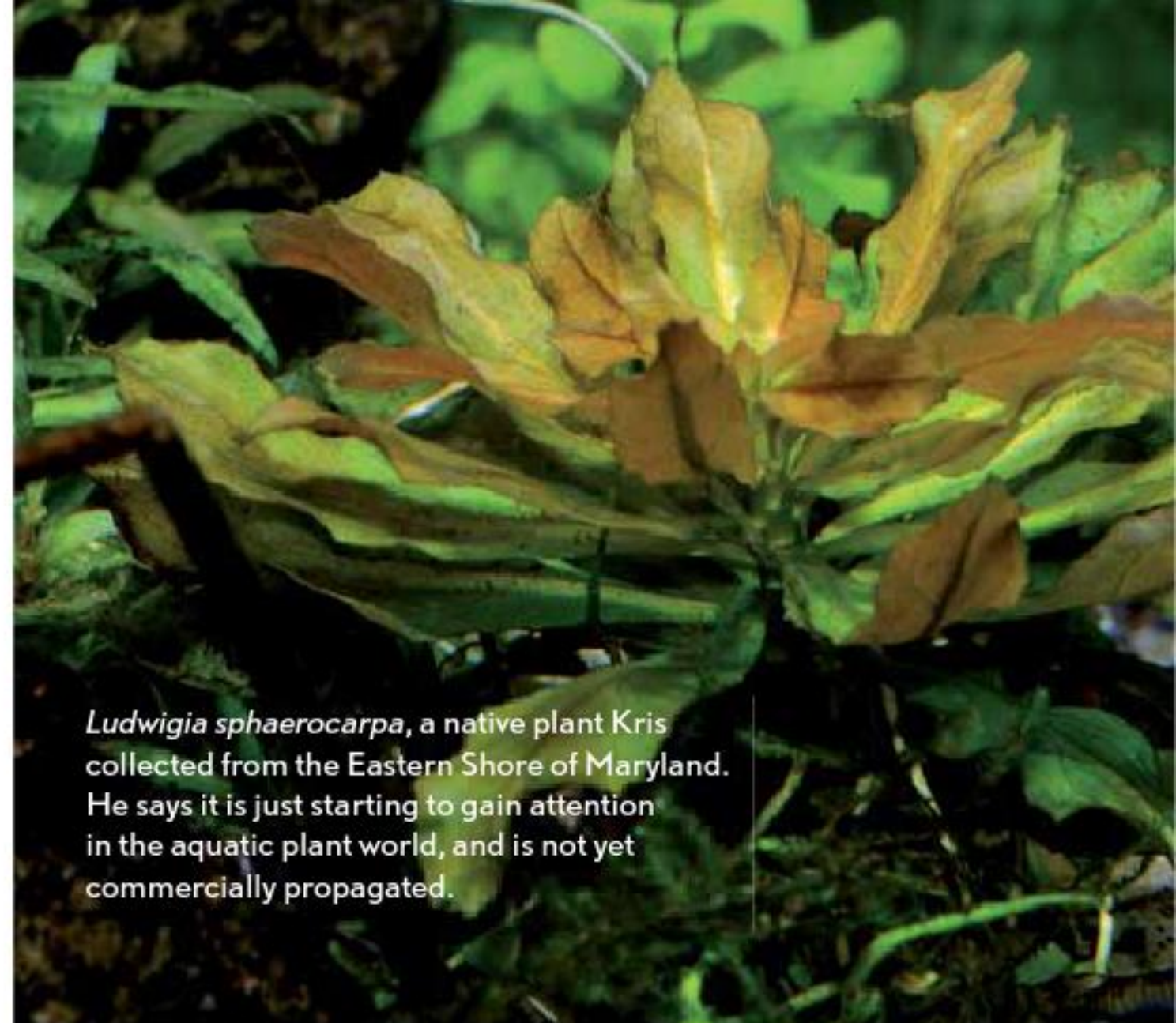
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*Ludwigia sphaerocarpa*, a native plant Kris collected from the Eastern Shore of Maryland. He says it is just starting to gain attention in the aquatic plant world, and is not yet commercially propagated.

club. His first planted tank was a reincarnation of the aquarium he had had through childhood—a 20-gallon (76-L) high. Through trial and error, and by refining his equipment and techniques, Kris evolved into an expert in high-tech tanks. He notes that he “first upgraded to power compact strip lights, starting with one and then adding a second. I tried do-it-yourself CO<sub>2</sub> yeast reactors first to ensure that carbon dioxide really helped the plants. Then, I bought a simple Dupla CO<sub>2</sub> regulator. Both of these things pushed me into regular CO<sub>2</sub> fertilization.

“The biggest challenge in a planted aquarium is establishing equilibrium in the tank and maintaining it,” Kris says. “For example, you set up an aquarium with new plant-specific substrate and throw in a bunch of plants. There are nutrients in the substrate, so you don’t have to dose many fertilizers. The plants start growing, and all of a sudden the substrate nutrients aren’t enough. So you start dosing fertilizers, and the plants go crazy. Then you do a huge trimming, and it takes a little while for the plants to recover and take off again. You likely want to reduce your dosing slightly. If you do regular water changes you don’t have to worry about these things as much, but learning proper dosing takes time and trial and error. Likewise, if you add a new light to your aquarium, it changes how fast or slowly your plants grow.”

Kris shares his experiences at [www.guitarfish.org](http://www.guitarfish.org), a blog he started in 2006. He spends a lot of time describing his setups, explaining the trials and tribulations of the hobby, and reviewing new products. Recently he has been focusing on LED lighting, and is in the process of converting all of his older fixtures to LEDs. As more and more companies begin manufacturing and marketing products designed for planted aquaria, Kris says we can expect this area of the market to continue to expand, making it easier for those interested in planted tanks to find success. He started his blog as a journal, and recommends that every hobbyist “keep a photographic journal, especially aquascapers. It’s fantastic to be able to

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go back and see how your tank has progressed from week to week and month to month. You learn how fast certain plants grow, when to trim them, and so on.”

I asked about his “secret formula” for success with aquatic plants. Kris says it is not much of a secret, as it can all be found on his blog, but the following are his preferred choices for planted aquaria and his opinions on options currently available in the North American market:

**Substrate:** “Mostly ADA (Aqua Design Amano) Aqua Soil, although I have tanks with other substrates, including a DIY of worm castings capped with old Aqua Soil. I’m constantly trying new things when they come out. By and large, I think that after six months, the substrate you use is less important, as it’s likely not

providing much nutrition by that point. If you’re only keeping root-feeding plants, mineralized soil substrate may be an exception, but even that will benefit from extra fertilization at some point. For me, it’s worth the price for the aquarium substrate that holds plants down better, initially kick-starts the tank with nutrients, and looks a little bit more natural. There’s a large price range in aquarium substrates, and much of the choice comes down to aesthetics, which may or may not be worth the cost.”

**Lighting:** “All LED. You need to ensure that the intensity of your light meets the light requirements of the plants you’re trying to grow. I would love to see all the manufacturers print PAR readings at standard depths on their boxes, so it would be easier to compare fixtures.”

**CO<sub>2</sub>:** “Pressurized CO<sub>2</sub>, and turn it up! I crank it as high as I can without causing the fishes stress.”

**Fertilizers:** “I dose dry fertilizers daily during the week. Monday, Wednesday, and Friday I dose macronutrients (NPK or Nitrate-Phosphate-Potassium), KNO<sub>3</sub> (potassium nitrate for nitrate), and KH<sub>2</sub>PO<sub>4</sub> (potassium phosphate for phosphate). Tuesday, Thursday, and Saturday I dose micronutrients (trace elements plus iron). Sunday I do water changes.”

**Hardscape:** “I’ve seen a ton of fantastic aquascapes done with hardscape materials that were free, collected nearby. Most of my hardscaping material falls in this category. I have also bought expensive hardscaping material that has a specific look or character that I couldn’t find nearby. It’s not necessary to spend a lot to be successful, but designer stones and wood can be the missing piece in your dream aquascape.”

**Other:** “Do regular and consistent water changes and keep up on your filter maintenance and mulm/detritus removal to prevent too many algae-causing organics from building up in the tank.”

As featured on the Reef2Rainforest/AMAZONAS blog, Kris was one of a panel of judges selected for the 13th Aquatic Gardeners Association (AGA) Aquascaping Com-

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Near right: A hardscape emerges as Kris creates a 12-gallon (45-liter) scene. Far right: The same Mr. Aqua Bookshelf Tank after several weeks of growth with bright LED light and carbon dioxide fertilization. He advises aquascapers to document their work with photographs.



petition. Kris points out that the AGA's website contains a full collection of photographic entries all the way back to 2000 (<http://showcase.aquatic-gardeners.org>). He says that everyone should look through them to gain inspira-

tion for his or her next tank. He reveals that every judge comments on every tank, and encourages anyone who wants to get better at aquascaping to submit a tank to the AGA. Even if you don't win, you get valuable feedback on how to improve your skills. All entrants are automatically entered into Amano's ADA competition.

As a member of GWAPA and an officer of the board, which is hosting the next AGA Convention in the DC area, Kris offers the following advice to those entering an aquascaping competition:

- Take pictures of the process, particularly when designing your hardscape, to show how the aquascape will look in the final entry you submit. Better to catch problems early on.
- Take the equipment out of your tank and put more light on top of the aquarium before you photograph it.
- Make sure your substrate is smooth and level in front.
- Clean your glass!
- Don't cram in 50 plant species. Choose 5 to 10 and repeat them throughout. Intersperse the species; wild plants don't usually grow in monocultures.
- Make sure your substrate and hardscape work well together. Don't use white rocks and black substrate, or pea gravel with volcanic rock.
- Fish size and tank size should match. Don't put a full-sized discus in a 20-gallon tank. In fact, smaller fishes are better—they won't dominate the aquascape.
- No gimmicks. Waterfalls and gnomes are fun, but the judges prefer to see natural scenes.

Federal bans on importing or selling certain species can be a major problem. I asked Kris about the federal noxious weed list and recent attempts to pass legislation imposing blanket bans on specific plants.

"Some people are in favor of limiting the types of plants and fishes that we are allowed to keep to a small, approved list.

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Obviously this would destroy the hobby. That being said, noxious weeds and invasive species can severely damage our native environments, and it costs real money to control them in the wild. All aquarists must ensure that the flora and fauna they keep remain in their own aquaria. Never dump a plant or fish out in the wild, even if you originally collected it there. (It can acquire diseases or parasites while in captivity.)

“It only takes one instance of an aquarist being linked to destroying a native ecosystem to have the legislative tide turn against us and limit our rights to keep what we take for granted now.”

Kris offered these final words of wisdom: “Try every plant you can. I am often asked, ‘Is this an easy plant?’ The honest truth is that it depends. Different plants like different conditions, and tank conditions vary. Besides, if you kill a plant, you don’t feel nearly as bad as you do

if you kill a fish. So there’s really no excuse not to try a plant you’ve never heard of.” 🐟

**Rachel O’Leary** breeds and sells nano livestock through her company, *Invertebrates by Msjinkzd*, in Mount Wolf, Pennsylvania, <http://msjinkzd.com/>.

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AMAZONAS

# *Betta hendra*: a new fighting fish from Kalimantan Tengah



by *Stefan van der Voort* • In 2009, a new *Betta* species was imported from Kalimantan Tengah, the Indonesian province on the island of Borneo, for the first time. It later found its way into the hobby under various trade names, including “Palangkaraya,” “Sabangau,” “Sengalang,” and “Palangka.” Now the species has been named *Betta hendra* (Schindler & Linke, 2013) in honor of its discoverer and first exporter, Tommy Hendra of Kurnia Aquarium in Kalimantan Tengah, Borneo.

The new species lives in the marshes of the Sungai Sebangau drainage south and west of the city of Palangkaraya. In May 2011, the water there had the following values (quoted from Schindler & Linke, 2013): pH ~4, electrical conductivity 6  $\mu\text{S}/\text{cm}$ , temperature 83.3°F (28.5°C). The slow-moving water flowed among trees and bushes that offered a lot of shade. The water depth was only 2–20 inches (5–50 cm).

*B. hendra* belongs to the *Betta coccina* group. The species differs from the other species of the group in color—its body and unpaired fins are bright green, and the other members of the group are darker in color—and, except for a large lateral spot in some species, it lacks the

iridescent scales. *B. hendra* differs from *B. uberis* by the smaller number of dorsal fin rays.

Hendra’s fighting fish is a foam nest-builder that grows to a length of about 4.5 cm (1.75 inches). It is available from specialized aquarists. Because it is so attractive, it is likely to become well established among labyrinth fish friends. 🐟

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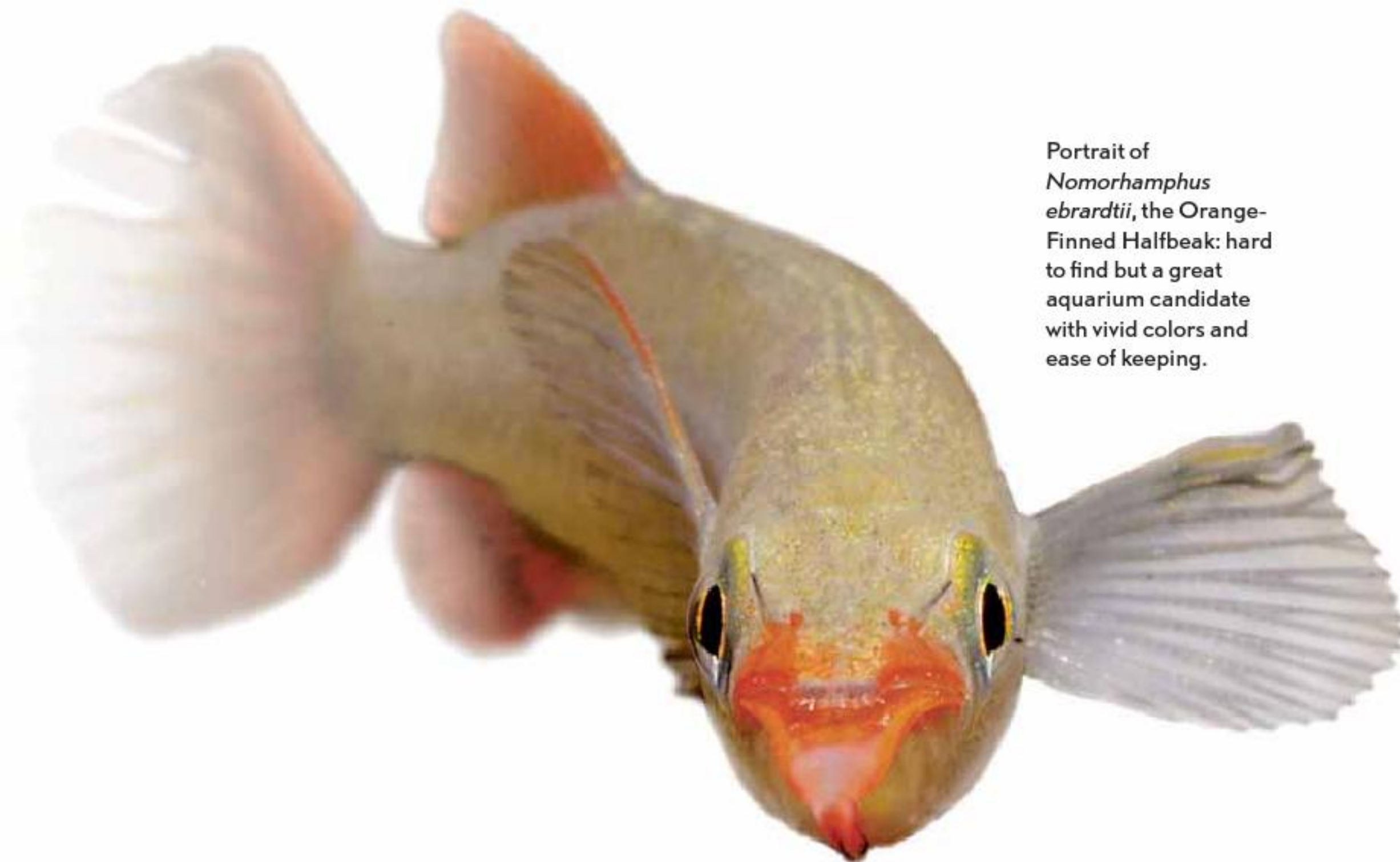
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Portrait of *Nomorhamphus ebrardtii*, the Orange-Finned Halfbeak: hard to find but a great aquarium candidate with vivid colors and ease of keeping.

by Jan Huylebrouck • Halfbeaks have been known to science for almost 200 years. At least three of the five genera of the family Zenarchopteridae, which was only established in 2004, are characterized by giving birth to live young—vivipary or viviparity—that have developed as embryos in the body of the mother. Many of the Southeast Asian halfbeak species bear striking fin colors and show interesting behaviors. Still, viviparous freshwater halfbeaks have never achieved the popularity of other livebearers. Perhaps the time has come for that to change.

# VIVIPAROUS HALFBEAKS

of the family  
Zenarchopteridae

## Ambush predators

The eponymous and most conspicuous feature of the halfbeaks is their extended mandible (lower jaw), although in some *Nomorhamphus* species it is barely longer than the upper jaw. In juvenile animals, the lower and upper jaws are initially about the same length. Among *Nomorhamphus* and *Hemirhamphodon* species, the extended mandible often has a downward-bent tip that is intensely colored in dominant males, suggesting a signaling function.

However, the extended mandible has another important function: it aids in food intake. There is a thin cutaneous rim on both sides. The fish swims sideways toward its victim, the movable upper jaw breaks the water surface, and the prey is shoveled by the lower jaw and the rims into the mouth. Skin folds between the upper and lower jaws increase the mouth opening, which leads to additional suction. Stomach analyses have shown that many halfbeaks consume flying prey, mainly terrestrial insects that have fallen onto the surface of the water.


Some scientists have posited that the long lower jaw is not really a jaw at all but a specialized chin. A 2009 online post from the Wainwright Lab at the University of California, Davis states, "One idea that has some support is that the long chin is part of a specialized sensory device. Montgomery & Saunders (1985) showed that there are a series of lateral line pores along the length of the lower jaw, with neuromasts in between these pores. They argued that this long structure, equipped with the lateral

line pits, may function in prey detection." (See References, page 28.)

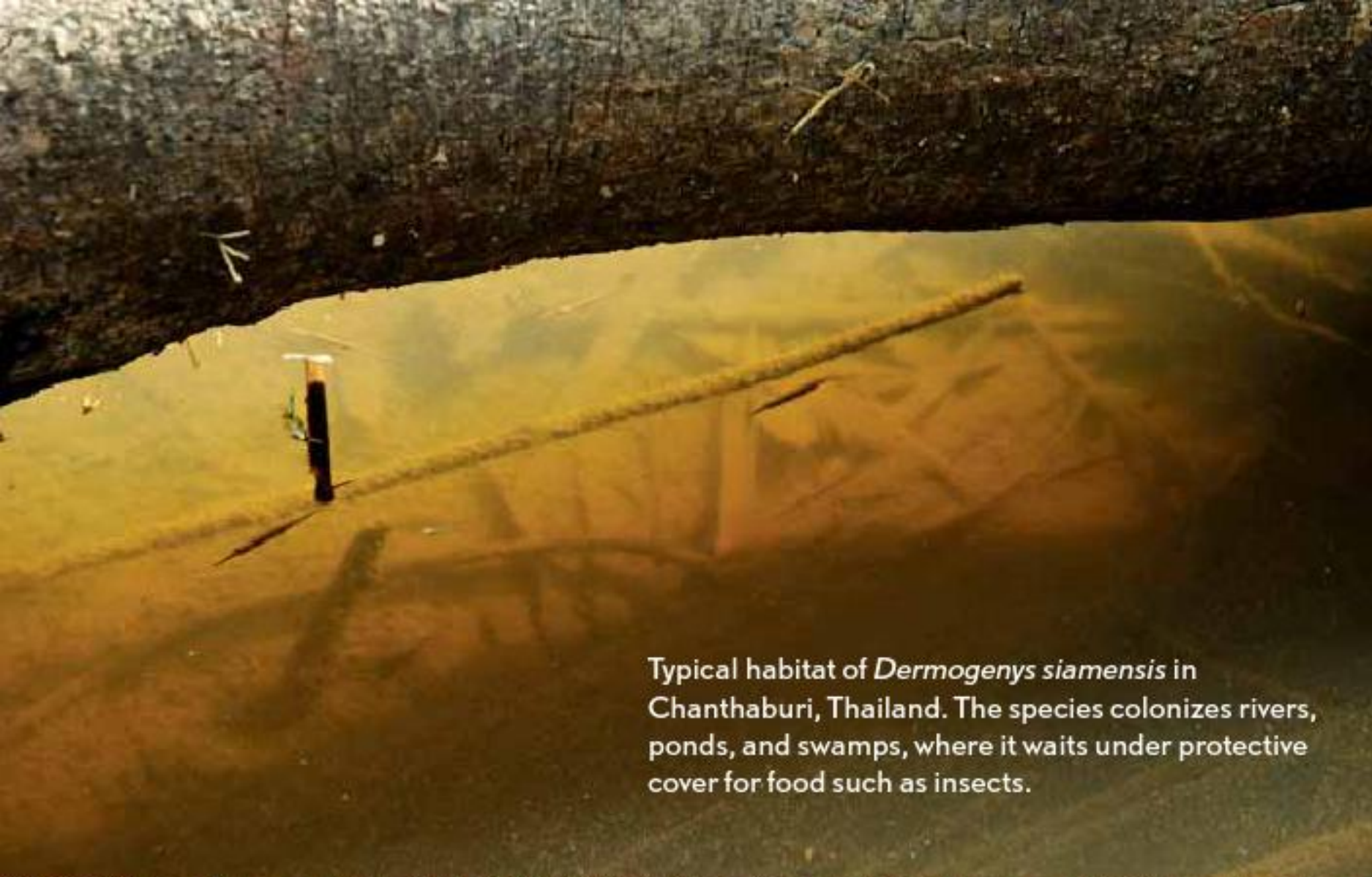
Halfbeaks are surface-oriented, with the exception of members of the genus *Nomorhamphus*, which are also found in other water regions. The sensory cells of the eyes are optimized for seeing upward and to the side. On the top of the head are the nasal barbels that represent the olfactory organ, atypically external for a bony fish. With their help, the olfactory cells are constantly exposed to water, even when the fish is standing still and waiting for prey. The hydrodynamic pike shape betrays that halfbeaks are mainly ambush predators that gain speed with the help of their tails and anal and dorsal fins.

## Posthumous description

In 1823, *Dermogenys pusilla* was the first viviparous halfbeak species and genus described by the young researchers Heinrich Kuhl and Johan van Hasselt in a letter that was sent to C.J. Temminck, the director of the Dutch Natural History Museum in Leiden. In 1820, Kuhl and van Hasselt were commissioned by the Dutch government to explore the wildlife of



Habitat of *Dermogenys sumatrana* in the estuary of Sungai Sarin near Kualatungkal, Sumatra. The species lives here in brackish water but is also found many miles upriver in pure, fresh water.



Typical habitat of *Dermogenys siamensis* in Chanthaburi, Thailand. The species colonizes rivers, ponds, and swamps, where it waits under protective cover for food such as insects.

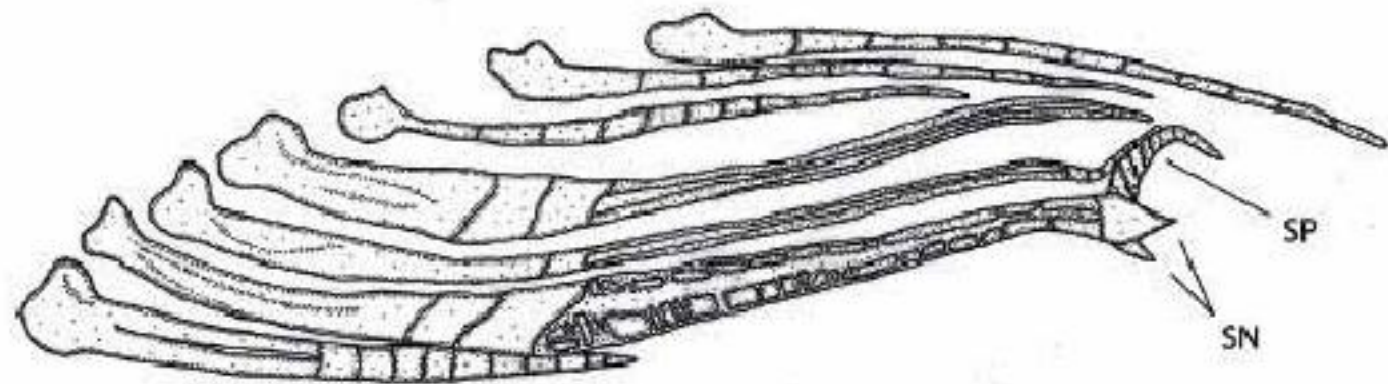


Java, then part of the former colony of the Dutch East Indies. They started their collection activities in Bogor, Java, where they found *D. pusilla* in the ponds of the local botanical garden. Even today, you can catch this species there.

In September 1821, Kuhl died a few days before his 24th birthday as a result of liver inflammation. Van Hasselt continued the work but followed his friend to the grave only two years later. Nevertheless, these men are regarded as the first describers, as the species was discovered and described during their lifetime. Last year, as part of a project sponsored by the Society for Ichthyology, I had the opportunity to study the conserved specimens of the genus *Nomorhamphus* in the ichthyological collection of the Zoological Museum in Bogor. I also visited the Dutch cemetery

Left: Habitat of *Hemirhamphodon phaiosoma* near Putussibau in the upper Kapuas River on Kalimantan, Borneo. The black waters here are very soft and acidic with temperatures of 81–84°F (27–29°C). The closely related *Hemirhamphodon kapuasensis* should also occur in these habitats in the upper Kapuas. Further downstream, the common *Hemirhamphodon pogonognathus*, with an extraordinarily long beak, inhabits similar places.

Right: Andropodium of *Nomorhamphus rex*. The tridens flexibilis consists of the spiculus (SP) and the spinae (SN), which are important for the taxonomy of *Nomorhamphus* and *Dermogenys*. Adapted from Huylebrouck et al., 2012.



Below: Holotype of *Nomorhamphus towoetii* in the Zoological Museum Hamburg.



where Kuhl and van Hasselt are buried, which is hidden in a bamboo grove in the botanical garden.

### Males with a trident

At least three genera, namely *Hemirhamphodon*, *Dermogenys*, and *Nomorhamphus*, are viviparous. However, it must be mentioned that *Hemirhamphodon tengah* is the only representative of its genus that deposits internally fertilized eggs. The reproductive biology of the genus *Tondanichthys* is completely unknown. *Tondanichthys kotlati* is known only from museum material consisting of young and probably immature animals used for the description in 1995. The reproductive biology of the genus *Zenarchopterus* is somewhat unclear, but we do know that the eggs are fertilized internally.

The males of the *Hemirhamphodon* species are unique

Right: Type specimen collection in the Zoological Research Museum Alexander Koenig, Bonn, Germany.



The shared grave of Kuhl and van Hasselt in Bogor, Java.

in that they are larger than the females. They have the same modified anal fin found in males of the other two viviparous genera. In *Nomorhamphus* and *Dermogenys*, the andropodium is formed from the first five to seven rays of the anal fin. In *Hemirhamphodon*, the andropodium usually consists of rays five through eight; the fifth and seventh or eighth rays are usually thickened and extended.

In *Dermogenys* and *Nomorhamphus*, the andropodium is modified further. The second ray is especially remarkable. At its end there is a structure called the tridens flexibilis (flexible trident), which is important for the taxonomy and species identification because it looks different in almost every species. Despite detailed knowledge of the morphology of the reproductive organs, we know next to nothing about their function. The mating of *Nomorhamphus* lasts only 1/25 of a second. It is assumed that the sperm packets are passed through a membranous groove between the second and fourth rays of the anal fin to the tridens flexibilis, and from there into the female genital opening.



*Hemirhamphodon phaiosoma* is a beautifully colored species. *H. kapuasensis* is very similar but so far, its import has only been rumored.



Female *Dermogenys sumatrana* are gray. They share this trait with almost all species in the genus.



Male *Dermogenys*, for instance *D. sumatrana*, often show red in the dorsal fin.

It is not clear whether or not the andropodium is inserted into the female genital opening; it seems unlikely because an axial rotation of the andropodium would be necessary, and that has never been observed. However, it could be that lateral huddling of sexual partners that rotate around their own axis make this possible. Such observations have been made but poorly documented. It is speculated by some that the andropodium is actually used as a clasping organ during mating. The courtship of *Dermogenys* and *Nomorhamphus* is striking in that the males “nip” with their mouths near the female’s genital opening. Presumably, this is to sense female hormones and ascertain whether the female is ready to mate.

The anal fins of the male *Zenarchopterus* are modified, but the modified rays vary from species to species. In at least some members of this genus, the extended dorsal fin in combination with the anal fin serves as a kind of clip during mating to immobilize the female laterally.

### Types of vivipary

The female reproductive biology of the sister genera *Dermogenys* and *Nomorhamphus* was studied in more detail by Meisner and Burns (1997). Five different types of vivipary were found. Types I and II are characterized by an intrafollicular gestation. The embryos thus develop mainly in the follicles and reside only a short time in the



The halfbeaks often have peculiarly shaped beaks, and sometimes the skittish animals damage them on the aquarium glass. Injuries like this one on *Hemirhamphodon phaiosoma* can result.



It may not look right, but this is what the beak of this *Nomorhamphus liemi* really looks like.

ovary, to be born with the next ovulation.

Embryos of type I lose mass during their development, suggesting that they are lecithotrophic (feeding only on existing yolk). In contrast, embryos of type II gain mass during development, due to the provision of nutrients by the mother (matrotrophy). In addition, type II differs from type I by viviparous superfetation, in which several broods can be fertilized in succession because the female stores sperm. As a result, up to three broods can develop simultaneously in the ovary. The different stages of development can be easily recognized. Types I and II occur in *Nomorhamphus vivipara*, a species endemic to the Philippines, and among *Dermogenys*.

Types III to V are characterized by intraluminal gestation. In this form of viviparity the embryos stay for only a short time in the ovarian follicles before migrating to the ovarian lumen, where they develop. Embryos of type III exhibit superfetation and matrotrophy and are typical for *Nomorhamphus* species endemic to the Philippines. Type IV, however, shows no superfetation. Here the embryo is supplied by the mother, but in a different way. While the embryos of type III are supplied with nutrients through highly modified structures in the ovary and embryo, these modifications are ab-



Mating of *Hemirhamphodon tengah*. This species lays internally fertilized eggs instead of giving birth to live young, as other *Hemirhamphodon* species do.



Two *Nomorhamphus* cf. *towoetii* males "nip" near the anal region of a female, perhaps to sense hormones.

Stillborn and dead eggs and embryos of *Hemirhamphodon kuekenthali*. The different stages of development of the embryos are clearly visible. The probable cause of death is the decomposed young fish at the top.



Members of the genus *Zenarchopterus*, such as *Zenarchopterus dispar*, are rarely imported. We know little about their reproductive strategies.



sent in type IV. Perhaps they absorb the nutrients from ovarian fluids.

It gets really exciting with the gestation of type V, demonstrated by *Nomorhamphus ebrardtii*. This halfbeak is quite widespread in the mountain streams of Sulawesi and is often the only species of this genus encountered in the German aquarium trade. In this species the embryos are also supplied with essential nutrients, but this happens in a more spectacular fashion. The embryos feed on eggs (oophagy) and smaller siblings (adelphophagy). Adelphophagy is not unique among halfbeaks; it is well documented in some species of sharks.

### Few aquarium observations

It appears that superfetation in *Dermogenys* and *Nomorhamphus* occurs only in species in which the embryos are supplied with nutrients and gain weight. In addition, matrotrophic species produce more numerous but smaller offspring than lecithotrophic species. Unfortunately, it is currently not known exactly how long the females are pregnant, how many pups they carry, or how big the animals are at birth, because long-term observations are scarce at the moment.

The few observations on this subject mentioned in the aquarium literature were collected by Greven (2006). According to him, the number of fry produced by *Dermogenys pusilla* varies from 9 to 165, but numbers of over 100 are exceptional; most females drop a maximum of 40 babies at once. *Nomorhamphus* females bear far fewer; usually there are no more than 12 to 16.

Meisner and Burns (1997) have counted pups during their study on viviparity. They counted up to 20 embryos in females with type I vivipary, up to 36 in type II, and up to 10 animals in types III and IV (there was no data for type V). In *Hemirhamphodon*, the numbers are still largely unknown.

Generally, a swollen female genital region is a sign of impending birth in viviparous halfbeaks. The babies are born head or tail first, usually in the protection of aquatic plants or other cover.

Viviparous halfbeaks are very interesting and attractive aquarium inhabitants. As mentioned earlier, we are still in the dark about some reproductive details, which is why I would like to appeal to all aquarists and ask them to accurately observe their halfbeaks and publish their results for the benefit of all.

### Taxonomy of the halfbeaks

The family Zenarchopteridae currently includes about 55 species from five genera: *Dermogenys*, *Hemirhamphodon*,

### Halfbeaks in the Aquarium

Most species of the genera *Dermogenys*, *Nomorhamphus*, and *Hemirhamphodon* are easily maintained in the aquarium. Because they prefer to swim near the surface, they mix well with other peaceful fishes that have approximately the same demands in terms of water quality but populate other levels of the aquarium. A few floating plants, a good filtration system with current, and regular water changes are basic requirements to maintain these fishes under appropriate conditions. The recommended water temperature depends on the particular area of origin.

**Tank size:** The size of the aquarium depends on the adult size of the species. The larger *Nomorhamphus* need a 36-48-inch (90-120 cm) tank, larger if it is a territorial species. The smaller *Dermogenys* and *Hemirhamphodon* can be kept in 24-inch (60-cm) aquariums. Some species, especially if wild-caught, are initially quite shy and bolt immediately. Floating plants provide them with the appropriate cover. Without it, the animals can injure their sensitive beaks on the glass walls.

**Feeding:** Halfbeaks are ambush predators that swim all day just under the surface and try to swallow everything that falls on it. Flake food and small granules are readily accepted. If you want to feed your animals really well, offer them cultured fruit flies (*Drosophila*) or collect meadow insects in the summer. Halfbeaks that have been fed with insects have larger broods and look healthier. The size and texture of foods can be important: *Nomorhamphus* tends to grab large pieces of food, such as hard food tablets, and this often causes the upper jaw to break. It then stands straight up and stays that way. If feeding dry pellets, be sure they are small in size or pre-soaked to soften them.

**Breeding:** If you want to raise numerous juveniles, capture the pregnant females with a large net coming from below and place them into a small aquarium prepared with dense floating vegetation. There the females can carry the fry and drop the young fish in peace. The mothers have an inhibition threshold and do not initially harm the fry. These inhibitions soon disappear, so the females should be returned to the parental tank. If it is an aggressive species, they should be placed in another aquarium for recovery. A later return to the group is not a problem.

—Hans-Georg Evers

*Nomorhamphus*, *Tondanichthys*, and *Zenarchopterus*. In contrast to the other genera, the representatives of the genus *Zenarchopterus* occur not only in brackish and fresh water but also in marine habitats. Their range extends from East Africa to Southeast Asia and Samoa to southern Japan; hence, they have the widest distribution among the zenarchopterids. The little-known genus *Tondanichthys*, with a single species, is known only from Lake Tondano on the Indonesian island of Sulawesi. The

species of the genus *Hemirhamphodon* differ from the other species in that they also bear teeth on the extended part of the lower jaw. *Hemirhamphodon* colonize small and moderately fast-flowing, soft and humic freshwater streams and rivers in the forested lowlands of southern Thailand, Malaysia, Sumatra, Borneo, and Java, which are rich in rainfall. *Dermogenys* is common in fresh and brackish waters throughout Southeast Asia. The species of this genus occur in Myanmar, Bangladesh, Vietnam, Cambodia, Thailand, India, Malaysia, Sumatra, Borneo, Java, Brunei, the Philippines, and Sulawesi. *Dermogenys pusilla* in particular seems to have become a synanthrope (a species that lives near and benefits from an association with humans) and is found in ponds and rice fields, but also occurs in mountain streams and coastal regions. *Nomorhamphus* is dependent on fresh water and occurs mainly in the mountain streams of Sulawesi and the Philippines. At least two species are also found in the great lakes of Sulawesi.

The family Zenarchopteridae (viviparous halfbeaks) belongs to the order Beloniformes, which is a sister order of the viviparous livebearers (Cyprinodontiformes) in the superorder Atherinomorpha. Until 2004, Zenarchopteridae only had the status of a subfamily (Zenarchopterinae) of the family Hemiramphidae (halfbeaks). However, detailed morphological and genetic analyses by Lovejoy et al. (2004) showed that the viviparous halfbeaks are

more closely related to the sauries (Scomberesocidae) and needlefishes (Belonidae) than to the halfbeaks of the family Hemiramphidae. These, in turn, are closely related to the flying fishes (Exocoetidae).

A very recent study of Southeast Asian Zenarchopterids (de Bruyn et al., 2013) suggests that the species of the genus *Dermogenys* endemic to Sulawesi are more closely related to *Nomorhamphus* than to the other *Dermogenys* species. This suggests that the genus *Dermogenys* constitutes an artificial group of fishes that is not monophyletic and requires a revision. However, further studies are needed to solve this problem permanently. 🐟

**Acknowledgments:** I would like to thank **Anna Schellenberg** (SMNS, Stuttgart) and **Fabian Herder** (ZFMK, Bonn) for their help and inspiration in creating this article. I would also like to thank the ichthyology departments of MPE (Bogor, Java, Indonesia), ZMH (Hamburg, Germany), and the Society for Ichthyology for the opportunity to examine the viviparous halfbeaks in their collections.

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ON THE INTERNET

Complete online references for this article: <http://www.reef2rainforest.com/references-viviparous-halfbeaks-of-the-family-zenarchopteridae/>  
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Image: Matt Pedersen

by Hans-Georg Evers • In recent years, the big, sprawling Indonesian island of Sulawesi has received more and more attention from the aquarium world. Quite a few aquarists have been seduced by the unimaginably beautiful shrimps and snails that occur there. The island is also home to some almost unknown species of fascinating fishes.

Hungry *Nomorhamphus megarrhamphus* pounce on anything that falls on the surface of Lake Towuti.

# THE HALFBEAKS

Overlooking Lake Towuti in the central highlands of Sulawesi.

THE FRESH WATERS OF SULAWESI are extremely species-poor. In the clear streams and rivers of the highlands and in the densely populated lakes, sometimes there are only one or two native species, competing against a broad range of invasive or introduced species. Both the ricefishes of the genus *Oryzias* (family Adrianichthyidae) and the viviparous halfbeaks in the family Zenarchopteridae have their centers of distribution on Sulawesi. The Adrianichthyidae are not killifishes but belong, with the Zenarchopteridae, to the order Beloniformes. Livebearing (viviparous) freshwater halfbeaks are a dominant fish group on the island. Many of them are endemic to Sulawesi. They share that distinction with another very interesting group of fishes: the sailfin silversides of the genus *Telmatherina* (family Telmatherinidae, order Atheriniformes).

Each reasonably intact, pure freshwater habitat of the island is home to at least one member of the three

groups mentioned. Usually a halfbeak species occurs together with a *Telmatherina* or *Oryzias* species, and they are typically accompanied by one or two gobies.

The closer you get to the coast, the scarcer the halfbeaks become. However, in the waters of the highlands they are ubiquitous. *Nomorhamphus*, in fact, are found only in the highlands; some *Dermogenys* species also occur in the lowlands, but far from the coast. Gobies dominate the fish fauna near the coast.

The ancestors of all these fish species are marine in origin, so these are secondary freshwater fishes. We find a greater diversity of native fishes, mainly from the families Adrianichthyidae and Telmatherinidae, in the famous lakes in the highlands of Central Sulawesi: the Malili Lakes and those located north of Poso and Lindu. With a few exceptions, the halfbeaks live in cooler riverine habitats.

This article focuses on the halfbeaks, but all the



# OF SULAWESI

other beautiful endemic species and their habitats certainly warrant more attention as well. Indeed, it is very likely that increasing human pressure (slash and burn land clearing, palm oil agriculture, mining, migration, and the invasion of foreign species) will impact most habitats. Sulawesi has no tigers or elephants, animals that often play a role in protection campaigns. Although most people are unaware of it, this unique island on the Wallace Line, with all its endemism and undiscovered beauty, is slowly but inexorably losing its biological riches.

I have long pondered how I could write this article without having it degenerate into a simple list of species and their localities. I decided to structure the piece around the different habitats and their inhabitants, starting with the lacustrine or lake species.



TOP: C. C. REUSCH; BOTTOM: H. G. EVERS



In the crystal clear water of Lake Matano, *Nomorhamphus weberi* prefers to live near the shore, in the shade of riparian vegetation.

#### ***Nomorhamphus weberi***

Two species of lacustrine half-beaks still live in Lake Matano, Lake Towuti, and Lake Mahalona in the central highlands. Once described as *Dermogenys*, they have since been transferred to the genus *Nomorhamphus* (Meisner, 2001). This shows how difficult the taxonomy of the fishes of the family Zenarchopteridae is (see

also the contribution by Huylebrouck).

In the warm waters of Lake Matano (84–88°F/29–31°C at 13 feet/4 m), a very pretty halfbeak lives in large shoals just below the surface, mostly in the shelter of overhanging vegetation. In some areas, I could make out hundreds of these fish. With their steel-blue bodies and orange-yellow beaks, they are very attractive. Unfortunately, we never succeeded in bringing live animals home and breeding them in the aquarium. Like many other fishes in the lake, *Nomorhamphus weberi* is extremely sensitive.

#### ***Nomorhamphus megarrhamphus***

With its yellow and black finnage, *Nomorhamphus megarrhamphus* from Lake Towuti has a certain appeal. However, a successful import has yet to be carried out. This fish colonizes the shallow shore areas in large shoals, waiting just below the surface for dropping insects. They can swallow large prey, as Christian Reusch's accompanying photo on page 31 impressively demonstrates.

On my first trip to Lake Towuti in 2007, my friend

#### **Still waters**

In addition to the three species listed here, which are all found in large lakes, you could include the *Dermogenys* that inhabit the swampy regions and smaller ponds. However, since they occur in greater numbers in rivers, I would like to focus here on three species: *Tondanichthys kottelati*, *Nomorhamphus weberi*, and *N. megarrhamphus*.

#### ***Tondanichthys kottelati***

In the north of Sulawesi, near the tip of the Manado peninsula, lies Lake Tondano. From there Collette described, in 1995, the monotypic and almost unknown genus and species *Tondanichthys kottelati*. I have not yet visited this area, but I have asked several friends to look for the species. They reported that the lake has degenerated into an algae broth as a result of fish cages and severe pollution from the people settling there in recent decades (P. Debold, M. Kokoscha, pers. comm.). In Lake Tondano and in a smaller adjacent lake, there are no other fishes except *Tilapia* and *Gambusia*. Is *Tondanichthys* extinct?



*Nomorhamphus weberi* is an attractive species but very sensitive to being transported.



*Nomorhamphus megarrhamphus* is skinny and has yellow fins.



In the aquarium, male *Dermogenys orientalis* always swim close to cover and wait for a chance to mate with the females "standing" near the surface.

Jeffrey Christian and I caught large quantities of these halfbeaks in one draw with a very long seine. It was remarkable how many heavily pregnant females there were in the net. Despite being moved carefully with a cup from the seine into waiting tubs, the animals died within a few minutes. I barely managed to take some adolescent fish to the hotel for the evening photo shoot. The stress of capture immediately did them in. Indeed, in his 1982 description, Brembach reported that they were very sensitive.

On the night of our first day the moon was new, and the next day we made two very interesting observations. Early in the morning, the surface of the lake was dotted with thousands of white flowers. The water plants *Ottelia mesenterium*, which are abundant in the lake, had all opened their flowers at the same time during the pitch-dark night. And while snorkeling, I encountered thousands of newborn *Nomorhamphus megarrhamphus* moving in large swarms through the water. That was the only time during my three trips to the Malili Lakes that I found newborn fry, but it was also the only time I was there on a moonless night.

### **Dermogenys species**

One of the two originally described and still valid *Dermogenys* species from Sulawesi is *Dermogenys orientalis*. Max Weber described this species in 1894, based on material from the Maros and Palupa Rivers near the village of Tempe, South Sulawesi. The other valid *Dermogenys* species is *Dermogenys vogti* from the southwestern tip of Sulawesi Selatan, in the highlands of Topobulu.

Unfortunately, I could not find this place during my trips, nor could any of the locals direct me to such a place. The first description is simply a descriptive text, without pictures or figures. The figure in Meisner (2001) shows a relatively deep-bodied species with a short beak, almost like *Nomorhamphus*. So far, I could not corroborate this species, but there are three other species whose determination is still pending.

### ***Dermogenys orientalis***

The traveler who comes to Sulawesi usually lands at the airport of Makassar, the capital of the island, in the southwest of the province of South Sulawesi (Sulawesi



*Dermogenys* live in the shelter of overhanging vegetation in lowland rivers like this one near Lampuaua.

Selatan). It is worth taking the time to travel by car to the nearby highlands of Maros and admire the karst mountains and their unique flora and fauna.

To foster tourism, the Bulusaraung National Park was established in 2004. The park is famous for its numerous butterflies and beautiful waterfall on the Bantimurung River. In addition to the Celebes Rainbowfish, *Marosatherina ladigesii*, we found two halfbeaks in the Bantimurung. This river above the waterfall is the type locality of *Dermogenys montanus* Brembach, now a synonym of *Dermogenys orientalis*. The water flows quickly over a

stony bed. The pH is quite high at 8.0 (conductivity 360  $\mu\text{S}/\text{cm}$ ), and the water temperature is moderate at 77°F (25°C).

Outside the park boundaries, below the waterfall, we caught *Dermogenys orientalis* relatively easily with a net. In addition, we collected several large females of a *Nomorhamphus* species that proved to be relatively sensitive and were therefore released. If I had known that this would be my only opportunity to collect *Nomorhamphus brembachi* alive, I would have tried everything to catch more animals.

Female *Dermogenys orientalis* are quite aggressive; they are constant skirmishing and sparring with open beaks.





Female *Dermogenys* sp. "Sungai Lampuauá"

*D. orientalis* is a very pretty and robust species. It exhibits red fins and metallic-green flanks when it is content. A unique feature is the aggressiveness among the females, which is absent in any other species. If the aquarium is too small, the dominant female fights all rivals, attacking them with an open mouth. It is not unusual to observe mouth or "beak wrestling." I have only witnessed this form of competition in males of two local variants of *Nomorhamphus ebrardtii*.

A large aquarium with dense surface vegetation is required for this species, should you wish to keep and propagate them successfully. Large females (3 inches/8 cm) in my care dropped over 30 good-sized juveniles (0.4 inch/1 cm long) that ate *Artemia* nauplii immediately. It was striking that despite the best feeding and frequent water changes, the offspring reached less than two-thirds of the size of wild-caught animals and only a few juveniles reproduced later.

***Dermogenys* sp. "Sungai Lampuauá"**

Jeffrey Christian, Peter Debold, and I caught this large species, which grows up to about 3 inches/8 cm (adult females), at the northern end of the province of South Sulawesi (Sulawesi Selatan), north of the village of Masamba in the coastal lowlands. Sungai Lampuauá (referred to on some maps as Sungai Lamogawa) is a shallow, clear-water stream with a high flow rate (pH 8.16, 134  $\mu$ S/cm, 82.6°F/28.1°C). Under some bushes near the shore, Peter and I captured several dozen fish with the seine. After being caught, the fins were deep orange;

later, in the aquarium, they turned red. The species is not very aggressive and is easy to maintain, even in small aquariums (15 inches/60 cm long). As with other *Dermogenys*, breeding these imported wild-caught animals was easy, but the F1 females did not breed. Only once did my captive-bred animals produce offspring, so they soon died out. Other aquarists to whom I had passed on F1 juveniles were not successful either.

***Dermogenys* sp. "Wailanti"**

In 2008, I found the inconspicuous species *Dermogenys* sp. "Wailanti" in the province of Sulawesi Tengah, in the lowlands of Lake Poso in various clear-water rivers and in the swamps and ponds near Kolonodale on the east coast. In Sungai Wailanti, *Dermogenys* sp. "Wailanti" was numerous. Each cast of the frame net beneath the embankment produced several animals. This species lacks any kind of color, so it probably has limited interest for aquarists.

***Dermogenys* sp. "Malaulu"**

The gray species *Dermogenys* sp. "Malaulu" is very similar to *Dermogenys* sp. "Wailanti," but is more elongate and lives on the other side of the central highlands near the Malili Lakes in the lowlands of Bone Bay, in a clear, fast-flowing river called Sungai Malaulu (pH 8.0, 252  $\mu$ S/cm, 79.7°F/26.5°C).

As we hunted for these small fish that no one bothers to eat, the Indonesians were washing their cars in the same place, commenting loudly about how colorless the



*Dermogenys* sp. "Wailanti" is plain gray.



Breeding *Dermogenys* sp. "Malaulu" is difficult because the offspring gets progressively smaller from generation to generation—a common problem with all *Dermogenys* from Sulawesi.

fish were. My travel partner, Christian Reusch, and I did not get discouraged, and collected a number of animals. We are sure that *Dermogenys* sp. "Malaulu" is not easy to identify scientifically.

### **Nomorhamphus from riverine habitats**

The quirky *Nomorhamphus* occur on the island of Sulawesi and in the Philippines, from which a total of seven species have been described. Ten species from Sulawesi are currently considered valid and others are likely to be added. I was able to confirm most described and some undescribed species in their natural habitats on Sulawesi. I report on them here by location, beginning in the highlands of Maros, the place from which the first *Nomorhamphus* arrived in the hobby.

#### ***Nomorhamphus liemi***

In the mid-1970s Dieter Vogt, then editor of the German aquarium magazine *DATZ*, made a few trips to

Sulawesi with biologist Manfred Brembach. These trips, which were supported by the Indonesian export company Vivaria Indonesia, resulted in several descriptions of halfbeaks that might upset some people today because of their unorthodox form. These descriptions interested me, too, but for a different reason—I wanted to experience the region's habitats and fishes myself. Some 30 years later, I was able to do so, but the landscape had changed significantly, and only a few of these habitats are still intact in South Sulawesi. There are now rice fields as far as the eye can see, and no stream remains unaffected.

*Nomorhamphus liemi* from around Maros was described by Vogt (1978a) in honor of the exporter Liem Dig. A subspecies described later, *Nomorhamphus liemi snijdersi* (Vogt, 1978b), is now considered a synonym of *N. liemi*. *N. liemi* is quite variable. Depending on location, the beaks of the males can be deep black, crimson red, or a blend of both. The species is one of the smaller forms and reaches a maximum of about 3 inches (8 cm)

for large females. I have tried and failed several times to find these fish, but they are still regularly exported. One local collector informed me that today the animals are caught further north, in the highlands near Palopo. He did not want to show me the places where he collects them. However, it is likely that the habitats here, like others in the highlands, are crystal-clear streams and rivers with slightly alkaline water, flowing hard over flat beds of stones and pebbles.

Liem's Halfbeak is peaceful and enduring in an aquarium. The females give birth to a maximum of about 10 very large juveniles (0.6–0.8 inch/1.5–2 cm). In my experience, adult females dropped babies three or four times before taking a break of up to a year, and then again produced fry several times.

Thus, if you want to keep this species, you need to separate the females regularly. A swollen genital region identifies the pregnant females, which are best captured carefully with a very large net coming from below. Be sure to proceed with caution so as not to damage the sensitive beak or stress the animals too much!

My birthing tanks for *Nomorhamphus* and *Dermogenys* hold about 8 gallons (30 L) and are densely planted. The females are fed well and generally drop their fry

early. In some species (*Nomorhamphus rex*, *Nomorhamphus ebrardtii*), waiting for the fry can become a game of patience. If you separate the females too early they may not give birth, or the young might be stillborn. *Nomorhamphus liemi* is certainly the most suitable species for the beginning breeder. Later you can try a different, more complicated species.

#### ***Nomorhamphus brembachi***


I caught Brembach's Halfbeak only once in Bantimurung. Originally, the species was described by Vogt (1978b) from around Longrong, near the east coast of South Sulawesi. Today it is no longer worth the trip, unless you want to see more rice fields.

*Nomorhamphus ravnaki*, its two subspecies *N. r. ravnaki* and *N. r. australe*, and *N. sanusii* (described by Brembach in 1991) are now considered synonyms of *Nomorhamphus brembachi*. *N. brembachi* and *N. liemi* males have a very pronounced black hook on the lower jaw. *N. brembachi* is quite variable in coloration, a trait it shares with *N. ebrardtii* from Sulawesi Tenggara, the southeastern part of Sulawesi.


*Nomorhamphus brembachi* is encountered in the trade every now and then. I suspect that they are caught in

A pair of *Nomorhamphus liemi*, the best-known halfbeak of Sulawesi and a great "beginner's halfbeak," sometimes sold as the Celebes Halfbeak.





Orange-Finned Halfbeaks, *Nomorhamphus ebrardtii*, from Wolasi. These are males in normal coloration.



Alpha male *Nomorhamphus ebrardtii* from Wolasi.

Bantimurung, because when we visited the national park we met some locals who told us that they occasionally catch fish there and sell them to a broker from Makassar to make a little extra money.

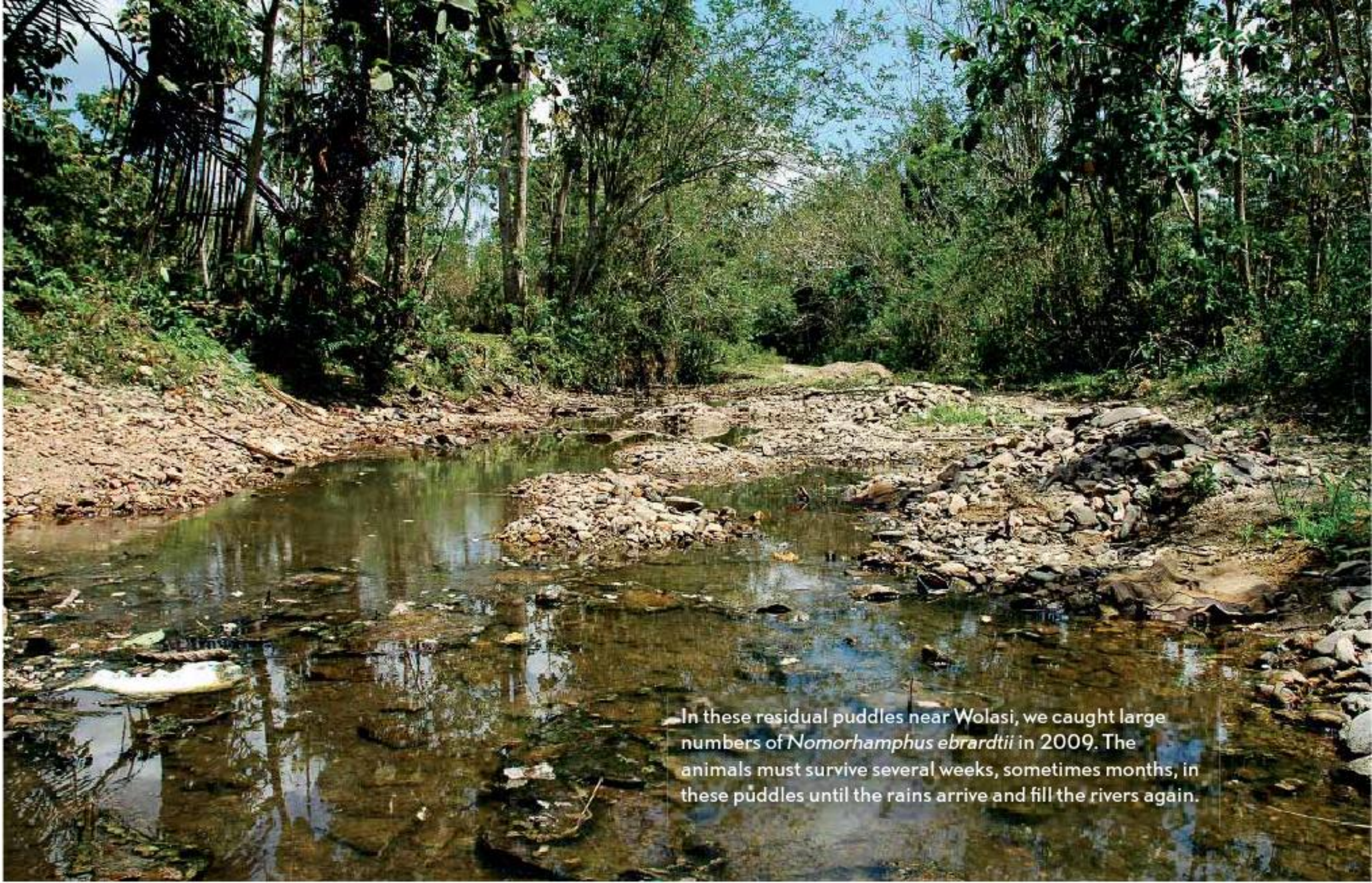
#### ***Nomorhamphus ebrardtii***

By far the most common halfbeak exported from Sulawesi is *Nomorhamphus ebrardtii*. It was described from Sulawesi Tenggara quite early (Popta, 1912). My brother Frank, Jeffrey Christian of Maju Aquarium, and I were able to confirm the species in September 2009 in the area of Kendari, in the remaining intact rainforest near Wolasi. This region is densely populated, and it is only a matter of time before the last intact habitats will be trashed or

burned. From the plane we could see how little is left of the rainforest's former beauty and could only imagine how it must have looked to the members of the Sunda expedition, which collected the fishes for the description.

I know of four local variants, and they differ significantly in terms of color. The forms from Sulawesi Tenggara and the island of Muna are orange; those from Balambano are bright red. The morphs of Sulawesi Tenggara, at well over 4 inches (10 cm), are larger than the other known *Nomorhamphus* species. The form from Balambano is significantly smaller (about 3.2 inches/8 cm).

We collected the morph from Wolasi at the end of the rainy season in residual water puddles (water temperature 89.6°F/32°C, 334 μS/cm). Beak, tail, and



In these residual puddles near Wolasi, we caught large numbers of *Nomorhamphus ebrardtii* in 2009. The animals must survive several weeks, sometimes months, in these puddles until the rains arrive and fill the rivers again.

dorsal and anal fins are stained orange. Dominant males have an orange head cap and parts of the pectoral fins are also orange.

We collected a second form in the Sumber-sari waterfall near Wolasi, but at a higher elevation (75.7°F/24.3°C, 260 µS/cm). This form proved to be the most productive, with up to 30 juveniles per litter. Its color is similar to that of the first form, but the alpha animals lack their intensity. The front half of the caudal fin is orange, but the back half is transparent. Some animals of this form should still exist in the hobby, because I have distributed them to many friends.

Both forms are living together with *Oryzias* sp. “Kendari,” a ricefish very similar to *O. woworae*, which was

described from the nearby island of Muna. On Muna, the most attractive and aggressive form of *N. ebrardtii* lives with *O. woworae*. The dominant males have a deep orange abdomen and are quite aggressive toward each other, even in large aquariums. The “beak wrestling” of adult males inevitably leads to the death of one of them.

An effective way to curb the aggressiveness is to keep a large group. In an aquarium with an area of 60 x 24 inches (150 x 60 cm), I started with 10 wild-caught animals (half males, half females); only one male survived. I then added the first 20 fry, and later even more, and the deaths ended.

In nature, *N. ebrardtii* not only hunts insects but also chases ricefish. I like to feed them large water beetles,

Male *Nomorhamphus ebrardtii* from the island of Muna have orange bellies and, like all forms of this species, bright neon-blue eyes.



Sungai Bantimurung in the karst mountains of the Maros highlands.



which they catch and devour after a wild chase. Fishes up to the size of a male guppy disappear within a few seconds into the beaks of these hungry predators. The form from Muna has been imported more than once and is still available from specialists.

A surprise for us was the discovery of a red color form that I am lumping in with *N. ebrardtii* for now. (After all, there is a whole mountain range between Sulawesi Tenggara and Sungai Balambano near the town of Malili.) The neon-blue eyes, short beak, and especially the fin coloration make it similar to *N. ebrardtii*, but the beak, abdomen, and unpaired fins are bright red, especially right after they are caught from the clear, fast-flowing stream (pH 8.0, 460  $\mu$ S/cm, 14°dGH, 76°F/24.5°C). Sungai Balambano is regularly visited by aquarium fish collectors, so this form has probably made its way into the market by now. It is also the only river on Sulawesi where I encountered two syntopic halfbeaks sharing the same habitat in the same range.

The second species is a smaller, black species. According to Kottelat et al. (1993), it is *Nomorhamphus towoetii*. I assumed at first that the larger *N. ebrardtii* would prevail as the dominant species in the aquarium. However, this was not the case. *Nomorhamphus towoetii* populated

the deeper water regions, and also does this in the aquarium. The little black devils quickly chased the *N. ebrardtii* through the large aquarium (60 x 24 x 20 inches/150 x 60 x 50 cm) and made them stay just below the surface.

#### *Nomorhamphus rex*

Just recently, a species was described from South Sulawesi that has been imported from time to time. Huylebrouck et al. (2012) described *Nomorhamphus rex* based on fishes caught in Sungai Toletole and in the drainage of Sungai Wewu. These rivers originate in the highlands west of Lake Matano and flow into Bone Bay. Much further east, and in Toraja, Jeffrey Christian, Peter Debold, and I were also confirming this species. The species settles in clear, fast-flowing waters with temperatures between 74.3 and

A pair of *Nomorhamphus ebrardtii* below a waterfall in Sumbersari.



The long lower jaw and the yellow pelvic and anal fins of the recently described *Nomorhamphus rex* from Central Sulawesi are unmistakable. This is a pair (male at the rear).



77.7°F/23.5–25.4°C (slightly alkaline pH, electrical conductivity between 200 and 400  $\mu\text{S}/\text{cm}$ ).

At first glance, *N. rex* is similar to its close relative *N. ebrardtii*, but it is smaller (males get up to 2.4 inches/6 cm, females about 3.2 inches/8 cm) and has a very long mandible (lower jaw) that is more than twice the length of the maxilla (upper jaw), particularly in males. The pelvic and anal fins of both sexes are yellow, and the posterior anal fin of males have black margins.

The species is not very productive, and wild-caught animals in particular are initially problematic. Only in the F2 generation did the number of fry increase (up to 11 animals); all of them survived. Since the species is caught in Sulawesi on a regular basis as an aquarium fish, it is sometimes available in pet stores.

#### ***Nomorhamphus hageni***

Popta (1912) also described *Nomorhamphus hageni* from Sulawesi Tenggara, a species that is a mystery to me. Meisner (2000) examined material from Penango (today Penanggo), a town north of the Menoke mountain range. I have not been there yet and therefore cannot write about this species. Whether or not the species is valid is questionable at the least. Since then no further specimens have been collected at the type locality, and the quality of preserved specimens is poor at best.

#### ***Nomorhamphus kolonodalensis***

To the north of the distribution of the above two species is the adjacent habitat of the Kolonodale Halfbeak. The species described by Meisner & Louie (2000) colonizes the region west of the port city of Kolonodale in the province of Sulawesi Tengah. In the immediate surroundings of the town, we found only swampy lowlands. Further south, in the hills of the Verbeekmas range (at the northern margin of Lake Matano), we discovered the species along with a new *Telmatherina* (*Telmatherina* sp. “Nuha”) near the village of Nuha. Sungai Suriya has fast-flowing water with a pH of 7.2, 112  $\mu\text{S}/\text{cm}$ , and a temperature of

Male *Nomorhamphus ebrardtii* from Muna “beak-wrestling.”





*Nomorhamphus kolonodalensis* has already been imported.

72.5°F (22.5°). Aquarium observations are not available because I did not bring any animals home. However, to my knowledge they were imported once or twice along with the *Telmatherina*.

### The black *Nomorhamphus*

The previous species were fairly simple, but it gets complicated now. The type species of the genus *Nomorhamphus*, *N. celebensis*, as well as *N. towoetii* and another very similar species available in the hobby (although its location is unknown), form a group of black halfbeaks worthy of taxonomic debate. Even the scientists are unable to agree and I am firmly convinced that something was mixed up in the revision of the genus by Meisner (2001).

#### *Nomorhamphus celebensis*

As the type locality for *Nomorhamphus celebensis*, Mohr (cited by Brembach, 1991) mentioned Lake Poso as well as a river in “Lappa Kanru.” No halfbeaks live in Lake Poso, as Brembach reported, and I have not found any *Nomorhamphus* in the lake on my two trips (2008 and 2010). However, in the many rivers surrounding the lake lives a halfbeak that I would describe as *N. celebensis*. Meisner (2001) designated a lectotype with type locality “Lake Poso,” collected by the brothers Sarasin. Through the collections of Heiko Bleher and others in the early 1990s, and mine about 20 years later, we now know that *N. celebensis* is a river-dweller. In Sungai Saluopa, a tributary of the great Poso River in the north of the lake, beneath the famous waterfall of the same name, this species is the only fish found in the clear waters of the sinter terraces (pH 8.5, 236  $\mu\text{S}/\text{cm}$ , 72°F/22.2°C). However, I was able to confirm it in many other places near the lake, down to Pendolo.

*N. celebensis* likes it cool and suffers over time if the water temperature is above 77°F (25°C). Large females can be up to 4 inches (10 cm) long. The females are always gray, while the much smaller males adopt a charcoal



The famous Saluopa waterfall is a tourist attraction and the habitat of *Nomorhamphus celebensis*, a black halfbeak.



In the aquarium, *Nomorhamphus celebensis* is one of the most peaceful species that we know. Although the males display all day, they do not harm each other.

gray to deep black color when displaying. Irregular, light gray vertical bands and spots interrupt the uniformity. In an aquarium 40 inches (1 m) long or bigger, the males squabble constantly but harmlessly while the females look on. Everything remains relatively peaceful, and I have never observed “beak wrestling” or battle injuries. Large females give birth to more than 20 quite large fry (0.5–0.6 inch/1.2–1.5 cm). This species is relatively straightforward to care for and easy to breed.

#### ***Nomorhamphus towoetii***

Among the few aquarists who work intensely with halfbeaks, this species is a constant topic of discussion. In the hobby, a black halfbeak has been successfully maintained for several years, thanks to the efforts of Ulrike Korte and friends. This form is similar to the *N. towoetii* described by Ladiges (1972) from Lake Towuti, with respect to the small size (about 3.2 inches/8 cm for females and 2.4 inches/6 cm for males) and the relatively short beak. The black color is not mentioned in the description. This species definitely does not live in Lake Towuti. Kottelat (1989a/b, 1990) reported clearly about his expeditions to the Malili Lakes and also mentions the species described above: *N. weberi* for Lake Matano and *N. megarrhamphus* for Lake Towuti. He also rules out the occurrence of *N. towoetii* in Lake Towuti, but describes the species in fast-flowing streams “in some



*Nomorhamphus celebensis* under water, below the waterfall. The dark male is stalking the larger, light-colored females in the current.

places in the Malili basin” (Kottelat, 1990). He described males and females and mentioned the deep black color of displaying males.

I suppose that because of Kottelat’s article, all black halfbeaks in the hobby came to be called *N. towoetii*, including the already imported *N. celebensis* near Lake Poso. This species is considerably larger and is much more peaceful than the little black hellions from Malili. The females of *N. celebensis* are light gray, while the females of *N. towoetii* can turn dark gray depending on mood. The form maintained by Ulrike Korte (2010) over many



An aquarium strain of *Nomorhamphus cf. towoetii* from an unknown locality. Note the orange blotches on the rear of the males' bodies and the brighter color of the female (above).



A pair of *Nomorhamphus towoetii* from Sungai Balambano near Malili. The females also turn dark during courtship.

Sungai Lawa is a cool, fast-running stream that flows into Lake Matano.

years is orange in the rear body area in both sexes, although the extent of the color varies individually. The females are always gray and do not turn dark. In addition, their half-beaks are significantly shorter than those of the fish that Kottelat (1990) considers to be *N. towoetii* and which was caught in Sungai Balambano near Malili in September 2011 by Jeffrey Christian, Christian Reusch, and me. The species lives there together with a form of *N. ebrardtii* (see above).

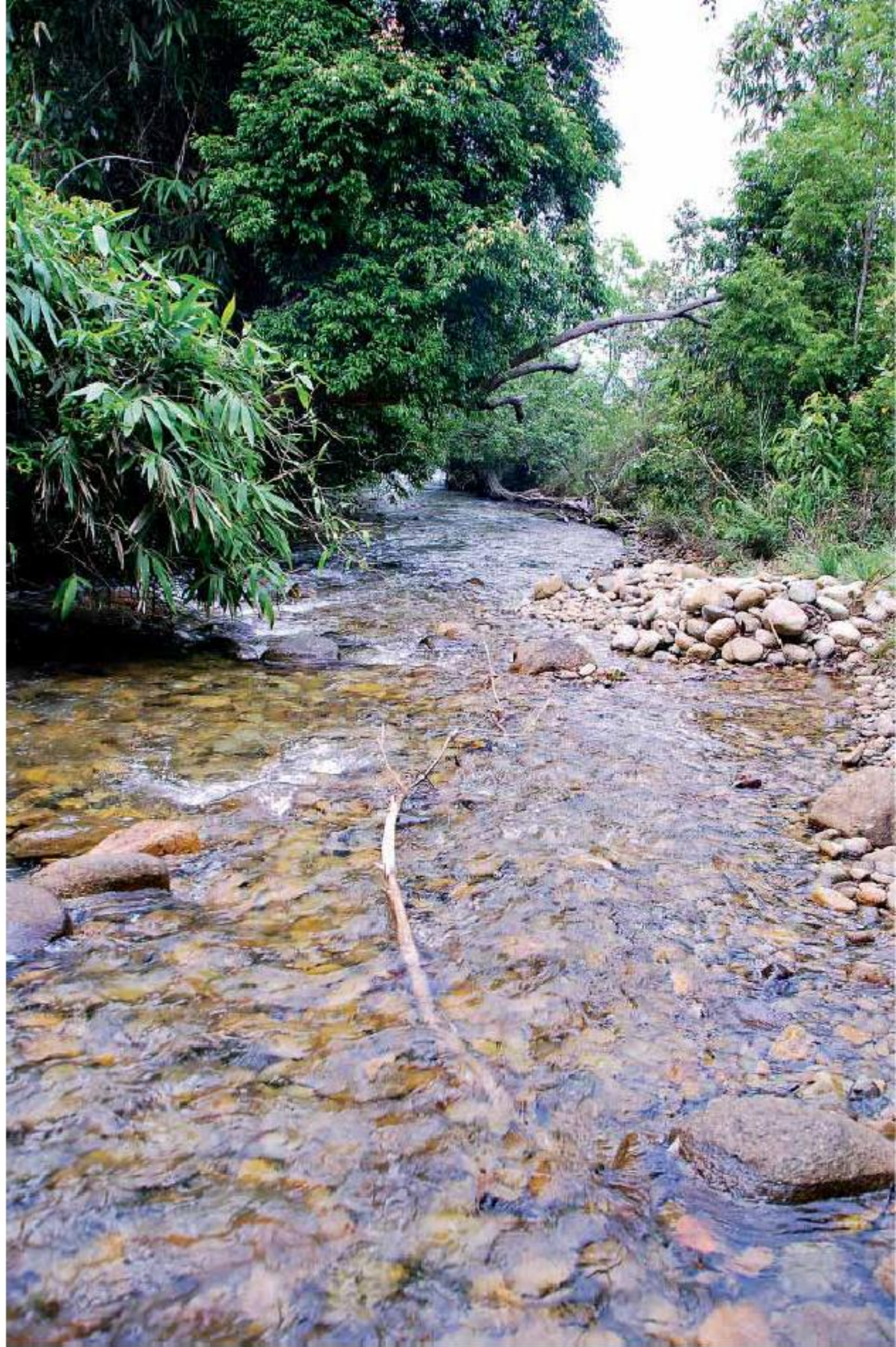
In the aquarium, the animals from Balambano are quite aggressive and even dominate the much larger *N. ebrardtii*. Husbandry has proved difficult and only a few young fish were produced (Reusch, pers. comm.). I could never discover the form cultivated by Korte on Sulawesi, despite intensive efforts. Because of their significant differences from *N. towoetii* (sensu Kottelat, 1990) I suggest that we call this fish *Nomorhamphus* cf. *towoetii*.

### Undetermined *Nomorhamphus*

In September 2011, during a trip I took to the Malili Lakes region with Jeffrey Christian and Christian Reusch, we collected three species of *Nomorhamphus* whose final determination is still pending.

#### *Nomorhamphus* sp. "Sungai Lawa"

Before I left for Sulawesi, Fabian Herder of Bonn gave me a tip: search for halfbeaks in



Male *Nomorhamphus* sp. "Sungai Lawa"

Female *Nomorhamphus*  
sp. "Sungai Lawa"



Pair of *Nomorhamphus* sp. "Wawondula"



***Nomorhamphus* sp.  
"Wawondula"**

On the road from So-roako on Lake Matano to Tinampu on northern Lake Towuti, we stopped at the village of Wawondula. Here, a small stream flows out of the mountains and collects in a reservoir above the road (pH 8.5, 7°dGH, 198  $\mu$ S/cm, 76°F/24.5°C) that eventually drains into a stream whose waters end up in Lake Towuti. Here lives *Nomorhamphus* sp. "Wawondula," the females of which attain

Sungai Lawa, a northern tributary of Lake Matano. He had previously caught only females of a *Nomorhamphus* species at that location, which has fast-flowing cool water (pH 8.5, 8°dGH, 73.4°F/23°C) and contains a population of *Telmatherina* cf. *bonti*, which penetrate into the lake. A few hundred meters upriver, we were lucky enough to catch the pictured *Nomorhamphus* sp. "Sungai Lawa." Freshly caught males show an intense yellow coloration in the fins. Dorsal, ventral, and anal fins have black margins in both sexes.

3.6 inches (9 cm). The males in particular show deep black fins, turn dark gray during courtship, and show some lighter vertical stripes (Reusch, pers. comm.). The accompanying pictures were taken in the evening at the hotel and do not come close to showing the true colors of the animals.

At the moment, Christian Reusch is struggling to breed these fish for conservation, which is quite difficult. The litters only average 10 fry and they are very sensitive, so only a few animals have been reared.



When aroused, male *Nomorhamphus* sp. "Salo Bombongan" become dark and exhibit yellow fins with orange seams.

Female *Nomorhamphus* sp. "Salo Bombongan" also have orange fin seams.



***Nomorhamphus* sp. "Salo Bombongan"**

One of the most adventurous trips that I have been part of was to Lake Masapi. I wanted to observe the recently described *Oryzias hadiatyae* and bring some live animals back to Germany.

In the morning, we set out by boat from Tinampu on Lake Towuti and crossed to Lambatu, an old logging camp on the eastern shore. From there we continued on bikes along an uphill trail toward Lake Masapi. On the way we crossed a small stream that the locals call Salo Bombongan, where both *Telmatherina* cf. *bonti* and the halfbeak *Nomorhamphus* sp. "Salo Bombongan" live.

These animals have turquoise eyes and show beautiful orange margins on the otherwise yellow unpaired fins. Immediately after capture the animals had a dark brown

color, but they lost it on the somewhat rough journey home. The species is quite sensitive to transportation, so we did not manage to bring any of them back alive. 🐟

**Acknowledgments:** For continued support in the field, I thank my friend **Jeffrey Christian** of Maju Aquarium (Cibinong on Java), and **Frank Evers**, **Peter Debold**, and **Christian Reusch**, who supported me in finding the halfbeaks of Sulawesi. **Fabian Herder** and **Arne Nolte** have been continuous sources of valuable information for years, and **Jan Huylebrouck** was kind enough to give the manuscript a critical read.

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**REFERENCES**

References can be found on the AMAZONAS (English) website: <http://www.reef2rainforest.com/references-the-halfbeaks-of-sulawesi/>

COVER

STORY



The three blue spots on the side are not bold but are clearly visible.

*Hemirhamphodon kuekenthali*

# The Magnificent Sarawak Halfbeak



A typical blackwater creek in Sarawak, the habitat of *Hemirhamphodon kuekenthali*.



by Ronny Kubenz and Rainer Hoyer • The viviparous Magnificent Sarawak Halfbeak, *Hemirhamphodon kuekenthali*, is a sleek, attractive surface fish that has only been imported for the aquarium trade in recent years. The animals are a bit skittish and like to jump, but otherwise they are not difficult to maintain and reproduce.

FRANK SCHÄFER PROPOSED the common name Magnificent Sarawak Halfbeak for *Hemirhamphodon kuekenthali*. I find it very appropriate, because in the correct light these animals look really gorgeous. As the name suggests, this species is widespread in Sarawak, where it is supposedly the only species of the genus *Hemirhamphodon*. All other species of the genus live in the Indonesian part of the island of Borneo. However, *H. pogonognathus* also occurs on Sumatra, Java, and the Malay Peninsula.

### Biotope near Kuching

During a trip to Borneo in September 2010, which was supported by Hendrick Michael, I had the opportunity to visit a number of interesting habitats and catch fishes. One of these trips took us to a typical acidic blackwater stream in a remnant of the rainforest, about 20 miles (30 km) south of Kuching, near the city of Serian. The water parameters were as follows: pH 4.1, conductivity 60  $\mu\text{S}/\text{cm}$ , total hardness 1°dGH (in 10 ml; Tetra-Test), alkalinity 0.5°dKH (in 10 ml; Tetra-Test), and water temperature 77.2°F/25.1°C.

The stream flowed almost imperceptibly. In this deep-brown water, no plants grew. The only cover for fishes consisted of shoreline vegetation and numerous broken branches and bamboo poles. The ground was muddy and covered with a thick layer of fallen leaves that offered additional refuges for small fishes.

These sanctuaries are definitely necessary, because among the first catch were hungry juveniles of the Giant Snakehead, *Channa micropeltes*. Also found here were the Redstripe Rasbora, *Rasbora pauciperforata*, and *R. cephalotaenia*, which is very colorful but only suitable for larger aquariums. The Striped Barb, *Puntius johorensis*, is slightly larger and very unusual. Hidden among the leaf layers we found a few *Betta ibanorum*. This is a subtly colored mouthbrooding fighting fish.

Finally, we caught *Hemirhamphodon kuekenthali*—but only a single adult specimen with a total length of 4 inches (10 cm). This fish may occupy a larger territory; we did not collect long enough to find more specimens.

### No mandibular extension

In 2011, *H. kuekenthali* was first imported to Europe by Tropic-Aquaristik and later by Aquarium Glaser. I received my animals from Tropic-Aquaristik, where they were referred to as Three-Spot Halfbeaks. This name is somewhat misleading, because although *H. kuekenthali*

has three blue dots on the sides, so do some forms of *H. pogonognathus*, with which the species is most closely related. Therefore, some forms of *H. pogonognathus* have entered the trade as *H. kuekenthali*.

However, these two species are fairly easy to distinguish from each other. *H. kuekenthali* has no mandibular extension on the tip of the lower jaw, its lower jaw is stronger and shorter, and the fin rays of mature males, especially in the dorsal and anal fins, are elongated. In dominant animals, even the upper and lower rays of the

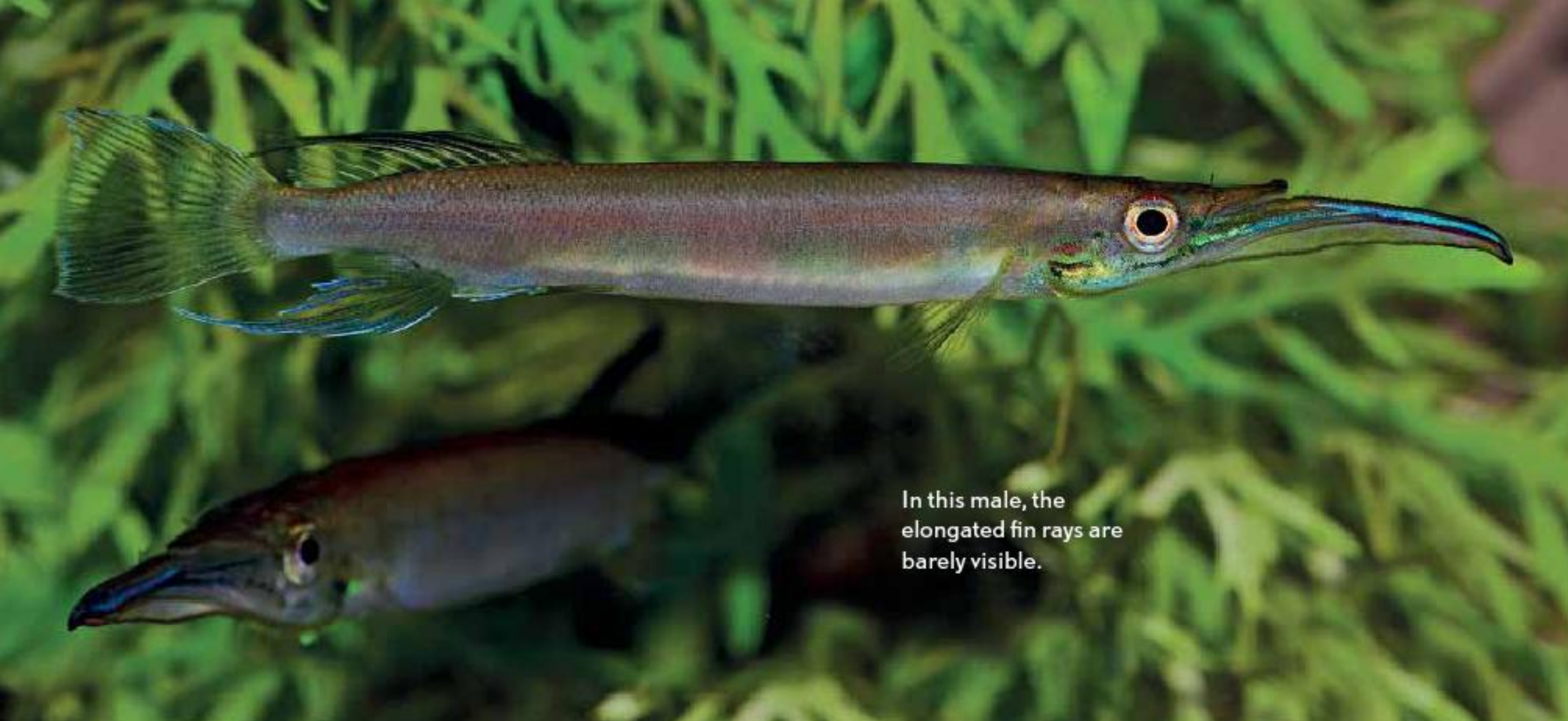


Above: *Hemirhamphodon kuekenthali* in the photo tank shortly after capture in the wild. Typical for *Hemirhamphodon* are the conspicuously large pores of the supraorbital canal, which probably help the fish detect surface movements. The mandible seams on the lower jaw can also be seen.

caudal fin are slightly extended.

The length of the fin extensions appears to be associated with nutritional status: the better fed the animal is, the longer the fin rays are. In nature, very elongated fin rays are therefore probably rare. These are used for display, threats and courtship, and mating, when they are used to embrace the female. The males reach a length of 4 inches (10 cm); females are slightly smaller at 2.4–3 inches (6–8 cm).

In addition to the three blue spots on the side, the



In this male, the elongated fin rays are barely visible.



This fish is taste-testing a leaf for edibility.

color of the lower head portion is typical. Depending on the light, it is red, blue, or green. When displaying, these colors are intensified. The fins are yellowish with white, sometimes red or blue margins; only the first rays of the dorsal fin are black. Stressed animals show a black band from the head to the caudal fin base. I suspect that this pattern also serves to demonstrate submission to inhibit the aggressiveness of a rival. Otherwise, the animals are rather gray, but their backs shimmer with a beautiful golden color in the right light. Therefore, a tank in the sunlight is exactly the right place for these animals.

### Omnivore

*Hemirhamphodon* species are residents of very acidic and soft water. Many fishes from these waters are quite susceptible to disease if they are kept in harder water. Not so *H. kuekenthali*; kept in tap water (pH 7.5, 2°dKH, 18–20°dGH), these fish show no susceptibility to disease. Even reproduction is not a problem.

They will eat basically anything that is animal and fits into the mouth. Even plastic and wood pieces are checked for edibility. However, these fish only accept food that is at or just below the surface. Occasionally, they swim after diving mosquito larvae. With the sensory organs on its head, the halfbeak can easily locate fallen insects on the surface. *Drosophila* and small crickets are particularly well suited as food.

The tank should be covered tightly, because halfbeaks are good jumpers. Especially at feeding time, things get so hectic that the animals scare each other and some try to jump out, occasionally ending up on the floor.

Unfortunately, when they are frightened by something, halfbeaks tend to ram into the glass and bend the lower jaw. Even in large tanks, this is hardly avoidable. To reduce the risk, I glue paper to the side and rear panes of the aquarium. The fish see that there is a barrier and slow down, albeit not always in time.

Socialization with other fishes is no problem, as long as they are not too small. However, larger bubble nest-building labyrinth fishes, such as gouramis, are not recommended; they may conflict with the halfbeaks or even hurt them. I keep them together with the Chocolate Gourami, *Sphaerichthys osphromenoides*, and the Striped Redeye Puffer, *Carinotetraodon salivator*, both fishes they live with in their natural habitat.

### Easy to breed

*Hemirhamphodon kuekenthali* is viviparous. For propagation, I put the female in a standard 15-gallon (54-L) tank. I set it up with a few stem plants, which provide cover, because the animals do not spare their own offspring. Since the species is superfetacious, a female can carry about 20 embryos in different developmental stages. In a large, dead 3.2-inch (8 cm) female, I found 23 em-



Females do not have extended fin rays.



In this male, the elongated rays of the dorsal fin are clearly visible.

bryos. You could wait in vain for an enlarged abdomen in a female as sign of impending birth, as it is in *Dermogenys* and *Nomorhamphus* species.

Every two or three days one or two juveniles per female can be skimmed from the surface with a cup in the morning (the birth usually takes place at night). In this way, I was able to harvest 31 juveniles from two females in two weeks. To locate the fry, simply look down into the tank. They can be fed *Artemia* nauplii and will grow quite fast.

The fry usually emerge without a yolk sac at a size of 0.4 inch (1 cm). If the females are stressed, under-

developed fry are born with a yolk sac still present. The juveniles, however, are fully viable and deplete the yolk sac within a few days. Frequently, this happens when the animals are being moved to a different tank or in a shipping bag. During one such move, two of my females in a bag gave birth to three young fish.

#### A surprise

Originally, I ordered four animals: one male and three females. The fish corresponded visually to the expected gender ratio. In a breeding experiment, in which I put all three alleged females into a breeding tank, I noticed



A young male *Hemirhamphodon kuekenthali*.

that two females mated. That surprised me, of course. On closer inspection, however, it turned out that one of the supposed females had an andropodium (male sex organ). Whether this organ was already visible when I received the animal or it developed later could not be established in retrospect.

After I put all three animals back into the maintenance tank, the original male figured out that one of the supposed females was a male. Of course, he did not like that and he attacked the inferior male. Unfortunately, I removed the weaker animal from the tank too late.

Nevertheless, it is not impossible to keep several males together in a group. Currently, I keep a group of about 15 males and 15 females in a 100-gallon (375-L) tank, which works fine. The males have formed a hierarchy and the dominant animal regularly sweeps the water surface free of the other males, especially in the morning. These subordinate males have to remain at least 4 inches (10 cm) below the surface; only the females are allowed near the surface. Matings are rarely observed. This is

certainly due to the fact that the females do not have to be fertilized very often and the dominant male is mainly engaged in chasing away other males.

When the daily chase is over, all the animals hover in the current near the surface and wait for food. Every now and then, the ranking is reinforced by threats and a short chase. According to Gross (1993) the females also form a hierarchy, but except for occasional threats among the females I cannot confirm that.

It is reasonable to assume that in nature, the strongest males guard a small harem. Therefore, the males of *H. kuekenthali* and *H. pogonognathus* are larger in relation to their females compared to the males of *Dermogenys* and *Nomorhamphus* species, in which the males swim around a group of females and compete for the right to mate. In these species, the females dominate the smaller males. Anyone who is looking for a nice and easy surface fish for a large tank should consider a shoal of these pretty halfbeaks. 🐟

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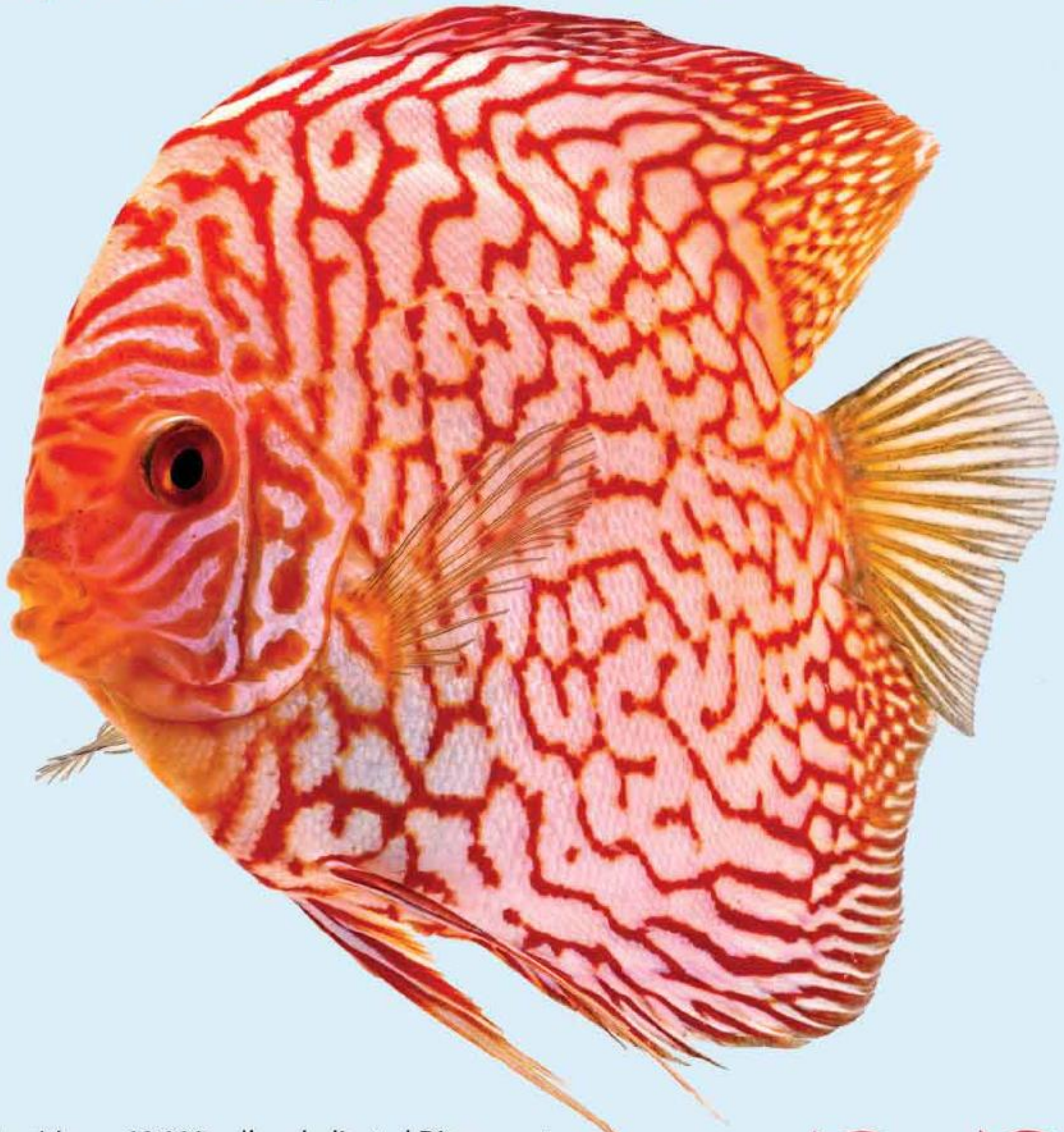
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A young fish shortly after birth.

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# A Planted Paradise in 18 Gallons



The author's 18-gallon (ADA 68-P) planted rimless tank displays a profusion of colors and textures. Inset: *Ammania* sp. 'Bonsai' is perfect for a planted nano aquarium.



*article and images by Sumer Tiwari* • Aquatic plants and aquascapes fascinate me, thrill me, and inspire me. They lift my spirits when I am down, bring me peace of mind amid the hustle and bustle of life, and bring out the best in me. In fact, they drive me to keep trying to improve.



Clockwise from top left:

Chili Rasbora (*Boraras brigittae*), a small, shoaling micropredator that does well in modest-sized planted aquariums.

The author's student-apartment system, with DIY LED suspended lighting and some plants growing emersed from riparium planters at one end of the tank.

A bird's-eye view of the lushly planted aquarium.



**MY AQUARIUM HOBBY BEGAN** just like anybody else's. I went from a fish bowl to a small tank, then moved to a bigger one and then an even bigger one. In each of my tanks I have experimented and kept different plants and fishes. Some of my aquariums have contained predominantly fishes, some mostly plants; others have featured both. I took a break from the hobby and did not keep anything for almost two years. However, in those two years my aquatic spirit never died, it grew stronger. When I reentered aquarium keeping, I was not keen on establishing an aquarium like those I'd had before; I wanted a tank that had the best of everything—the best light, the best substrate, the best plants, the best fishes, and the best system. My best tank.

Colors and textures were my motivation for this tank. I was highly influenced by Dutch-style aquascaping. I wanted to create an aquascape that was colorful and had a lot of texture in it. From the saw-leaved *Hygrophila pinnatifida* to the spiky *Eriocaulon* species, from the bullate (puckered or blistered) leaved *Cryptocoryne bullosa* to the lace-leaved *Aponogeton madagascariensis*, I had a wide range of options. I wanted the dark red *Alternanthera reineckii* 'Mini' playing off the brown-tinted, dark green *Cryptocoryne hudsoni*, the bright green *Staurogyne* sp. "Porto Velho" contrasting with the brown *Hygrophila* sp. "Brown," the pinkish orange *Nesaea crassicaulis* standing out against the brilliant green *Eriocaulon aquaticum*.



I wanted the shimmering effect of LEDs, the shine of a stainless steel CO<sub>2</sub> regulator, and the clarity of an ADA rimless 18-gallon (68-L) tank. For lighting I chose to build my own LED unit with a controller that can create a sunrise-to-sunset effect. Because different plants have different lighting requirements, I designed my LED fixture to provide high-intensity light in the center of the tank (around PAR 80–85). The light intensity decreases toward the walls of the tank (down to PAR 55–60). I researched extensively and finally came up with a mixed spectrum that includes red, cyan, green, royal blue, cool white, and neutral white LEDs. The total photoperiod is seven hours: two hours of dawn/sunrise, three hours of full sun, and two hours of dusk/sunset. My Red Melon Darios, *Dario*

*hysginon*, which are wild-caught fish from Myanmar, are thriving and reproducing under.

### Starting right

Past experience had taught me that I had to start the tank with lots of plants, because in the beginning new substrates leach a lot of nutrients, and if you don't have enough plants to take them in, algae will start showing up. I did 60–70-percent water changes every day for the first 15 days. I started with some hardy plants that I did not want to keep permanently in my tank, such as *Hygrophila corymbosa*, *Egeria densa* (Anacharis), and *Vallisneria*. Once the ammonia levels reached 0 and nitrates fell below 30 ppm, I took out these plants and added the permanent species.



Keeping a plant that is hard to maintain always gives me a thrill. I am constantly on the lookout for something that challenges me. I love nurturing them and watching them grow. I was especially fascinated by plants from the Eriocaulaceae (pipewort) family because of their bushy crowns, their growth pattern, and how beautifully they multiply. One by one the number of species that I had in my little tank grew to over 50. Out of these, 14 were from the Eriocaulaceae family.

Not every boat sails smoothly; I had my problems with this tank. Once I had a *Spirogyra* filamentous green algae breakout in my tank. I tried anything and everything to get rid of it, including treating it with hydrogen peroxide and glutaraldehyde (a medical disinfectant). When none of that worked I turned my efforts to doing water changes. I did a 70-percent water change every day

for about a week, and after that *Spirogyra* became history. After that I included water changes in my routine; now, I do a 40-percent water change every other day.

### Lessons learned

I have learned a lot from this small tank. Consider my experience of planting the same plant species at two different locations under the same intensity of light. One planting received a lot of water flow and the other patch got little or none. The specimens experiencing heavy water flow grew much longer leaves than the group that wasn't getting any flow.

I discovered that some plants can lose their beauty if planted in an area of high water flow. I watched this happen with *Tonina fluviatilis* "Lotus Blossom"—the stems don't remain straight if planted in a lot of flow. They like



Clockwise from far left:

*Persicaria* sp. "Kawagoeanum" (also known as *Polygonum* sp. "Pink").

Blueberry Shrimp, *Neocaridina palmata*, on Phoenix Moss, *Fissendens fontanus*.

Blossoming *Tonina fluviatilis*, known to be a challenging plant that demands soft water and intense lighting (at least 3 watts per gallon).

*Dario hyssginon*, Melon Red Dario, a species that the author found to be ideally suited to his densely planted tank. "I started with a group of 10," he says, "and now there are 30–35, although I have never observed them breeding." This is a small, peaceful species whose maximum length is less than an inch. These males, shown engaging in typical sparring behavior, display a brighter red coloration, are larger than the females, and have a black blotch at the front of the dorsal fin.

mild flow, which is just enough to bring new CO<sub>2</sub>-enriched water to them but won't move them a lot.

Biofilm is a natural phenomenon that sometimes can break the exchange of air/oxygen with water. When this happens, the water column becomes isolated and stagnates. CO<sub>2</sub> levels keep rising in the tank and ultimately the fishes suffer. I have found a surface skimmer quite helpful in this regard, and run one constantly. The powerhead that runs it creates more flow in the tank. The skimmer and pump constitute a regrettable case of "more equipment in the tank," but the benefits outweigh the aesthetic challenge.

I keep experimenting with the livestock in this aquarium. Initially I kept some Peacock Gudgeons (*Tateurndina ocellicauda*), but soon they started breeding. I was busy with my coursework and did not have time to take care

of the fry, so I removed the Gudgeons and replaced them with Pacific Blue-Eyes (*Pseudomugil signifer*) and Panda Loaches (*Protomyzon pachychilus*). But then my eye was caught by the Mosquito (Chili) Rasbora (*Boraras brigittae*), so again I reworked my fish population. Unfortunately, they did not like the high water flow in the tank, so I changed one more time, replacing them with what some call the Red Melon or Red Dario, *Dario hyssginon*.

I think these darios are truly the best fish for this aquarium. They can withstand very low oxygen levels. Males have a beautiful red color and they keep showing their aggression to maintain their territories. But having a good male:female ratio is also very important in order to keep them peacefully. I feed them only frozen food like *Artemia*, mosquito larvae, and bloodworms. Recently I spotted a two-month-old baby in my tank; I had had no



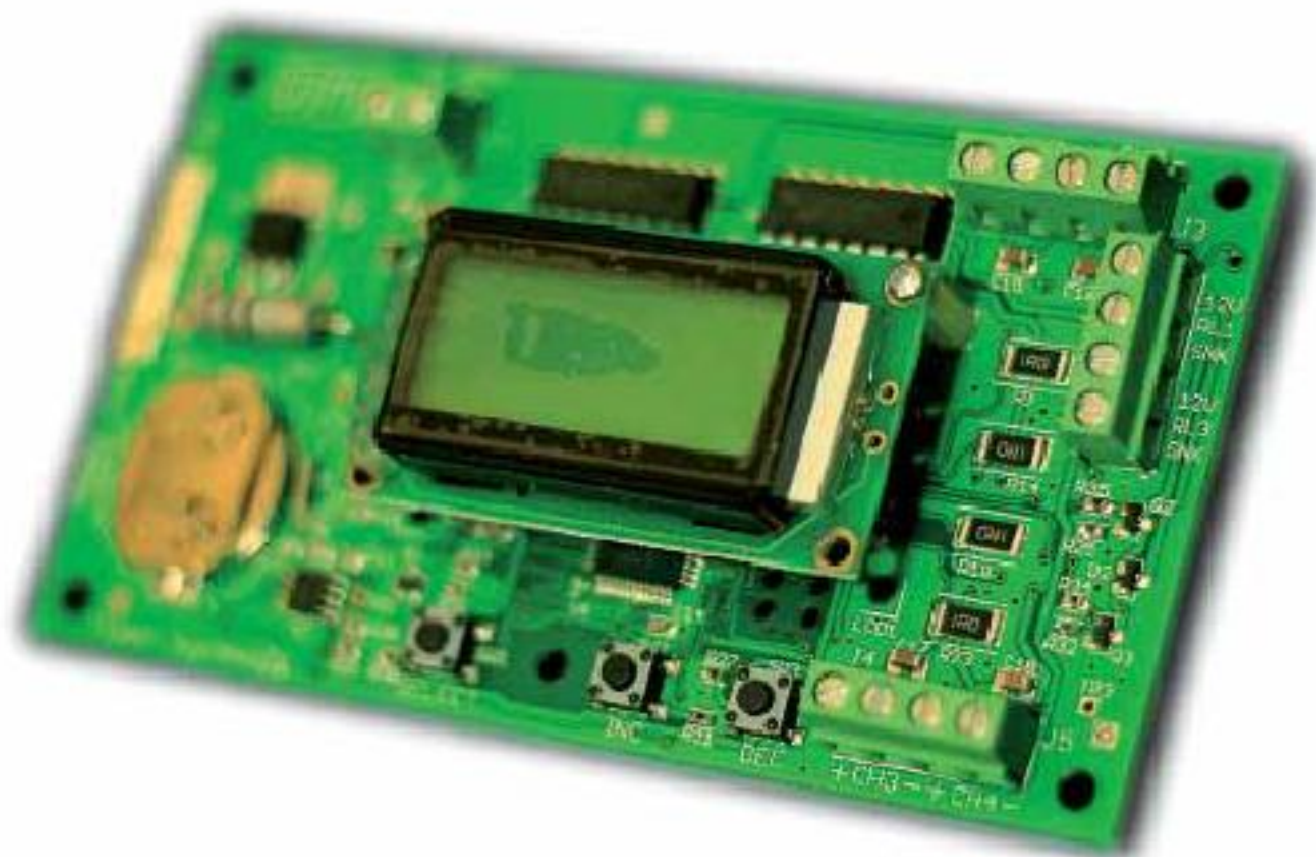
A Panda Loach perching in the profusion of healthy foliage, which offers security to small fishes.

clue that the darios had bred.

Throughout the many iterations of this aquarium's population, some fishes and invertebrates have remained. My algae control crew consists of four Golden Otocinclus (*Macrotocinclus affinis*) and four Amano Shrimp (*Caridina multidentata*). With so much going on in my day-to-day life, my primary goal is not to breed my fishes but to experience the pure pleasure of growing rare plants in my tank and improve my aquascaping skills. In the future I intend to keep numerous such tanks, each having its own unique combination of textures and colors. 🐟

**Sumer Tiwari** is a graduate student at Colorado State University, Fort Collins, Colorado. He is from Multai, India.

Tools for success (clockwise from top left): Author's DIY light controller; the Pfertz (large bottles) and ADA Nature Aquarium fertilizers he uses; stainless steel aquascaping instruments; carbon dioxide rig with pressure gauges and electronic switching control valve.



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An adult female blows a jet of water beneath a log to dislodge a food item.

# Breeding the Tiger Ray

## *Potamotrygon tigrina*



by Jennifer O. Reynolds • Every day, as I gaze upon the intricate gold and black vermiculation that makes up the bold dorsal color pattern of a Tiger Stingray (*Potamotrygon tigrina*), I see something new. No amount of staring at their incredible mosaic of pigment reveals all of the intricacies and beauty contained therein. It is this unique pattern that has earned the Tiger Stingray a reputation as one of the most beautiful of the freshwater stingrays and recently allowed it to be separated from its closest relative, *P. schroederi*.

The distribution of *P. tigrina* is not well defined, although most Tiger Stingrays in the hobby are exported from Iquitos, Peru. The type locality is Peru's Rio Nanay, a tributary of the Rio Amazonas, but scientists and exporters speculate that the range of *P. tigrina* may be more widespread in the upper Rio Amazonas, including the Rio Tigre and possibly even the Rio Putumayo.

Unfortunately, even less is known about the biology of *P. tigrina*, and more research is needed

to confirm maximum size, reproductive parameters, and population dynamics. Field research of freshwater stingrays is extremely difficult work, and even in the best situations, researchers typically do not have the opportunity to observe individual animals on a daily basis over a period of years, as we can with captive specimens. It is my hope that work with aquarium specimens can add to the knowledge base of this captivating species.

The Tiger Stingray has earned a reputation



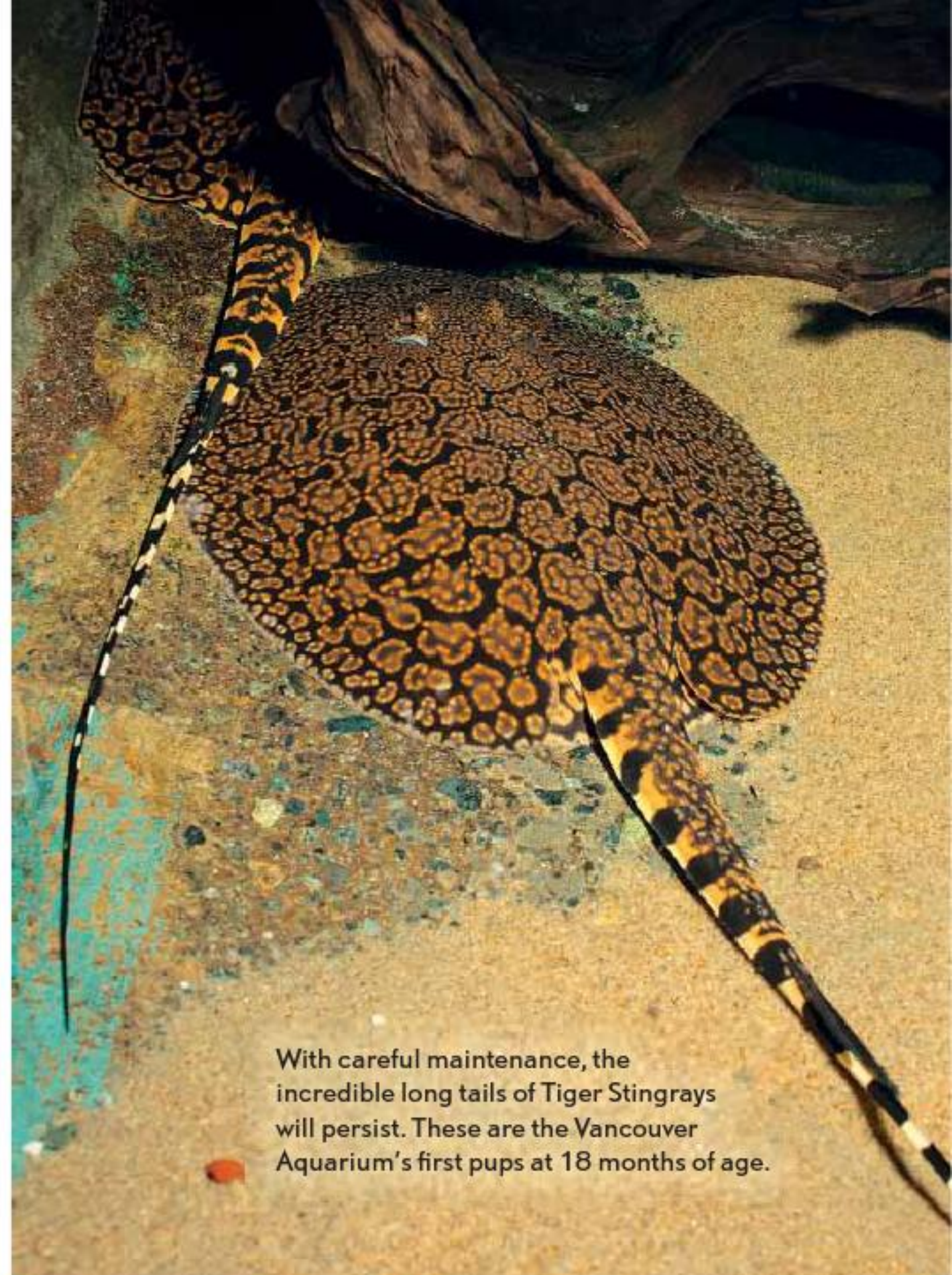
among aquarists for being a delicate and challenging species to maintain. While some aquarists have been successful keeping *P. tigrina*, there are very few reports of captive reproduction, especially when compared to the captive breeding success of other commonly kept *Potamotrygon* species such as *P. leopoldi* or *P. motoro*. The John G. Shedd Aquarium in Chicago, Illinois, reported the first captive reproduction I am aware of in 2005, as well as several other births in subsequent years. The following details are based on the Vancouver Aquarium's experience since we acquired this species in 2003.

### Arrival and acclimation

The Vancouver Aquarium's *P. tigrina* population comprises three animals acquired from Peru: one female and two males. The first male was acquired as an adult in 2003. In 2004, we acquired the female at the very small size of 8.7 inches (22 cm) disc width (DW). The second male was acquired in 2006 at 5.9 inches (15 cm) DW. As expected, some of the animals proved more difficult to acclimate than others.

The female was a particularly difficult animal to acclimate, possibly owing to her small size and poor body condition. She refused all food except for small live Goldfish placed under her disc with forceps. In time, she began to accept freshly dead Goldfish and, after that, refrigerated and eventually even frozen Goldfish. Unfortunately, she rejected all other food items in this initial period. At this point, I came

up with what I was certain was a brilliant idea to introduce other food items to this finicky stingray. I cut a small piece of frozen lake smelt, a staple food item we use for our other stingrays, and stuffed it into the abdominal cavity of the frozen Goldfish I planned to offer that day. I placed the Goldfish, laced with smelt, under her disc, and was at first thrilled to see her chewing it and eating it as expected—until she ejected the different-tasting piece of smelt out her spiracle. I had met my match! I persisted in offering the food this way until she finally accepted it, and slowly increased the amount of smelt inside the Goldfish over a period of about three weeks until she

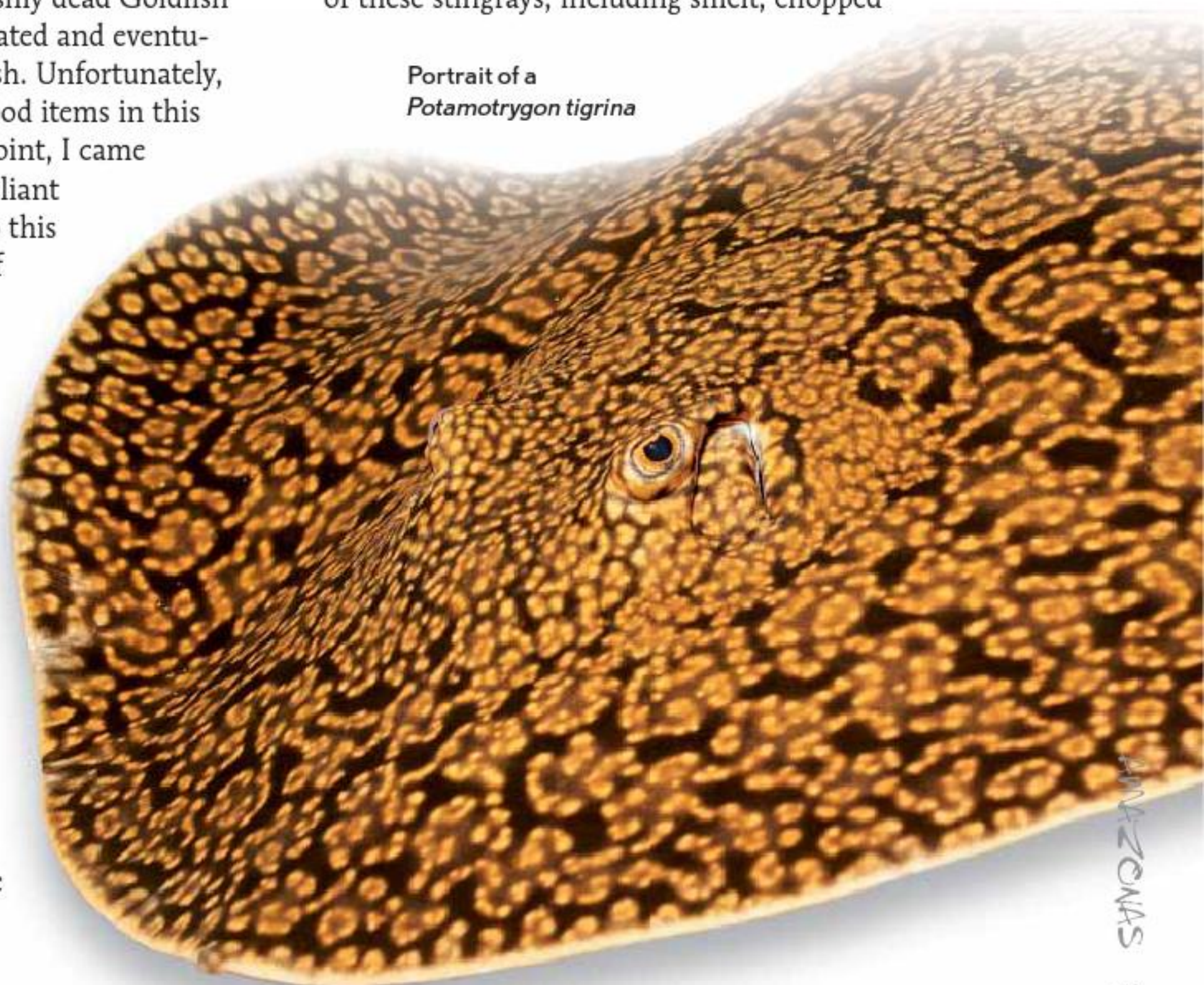


With careful maintenance, the incredible long tails of Tiger Stingrays will persist. These are the Vancouver Aquarium's first pups at 18 months of age.

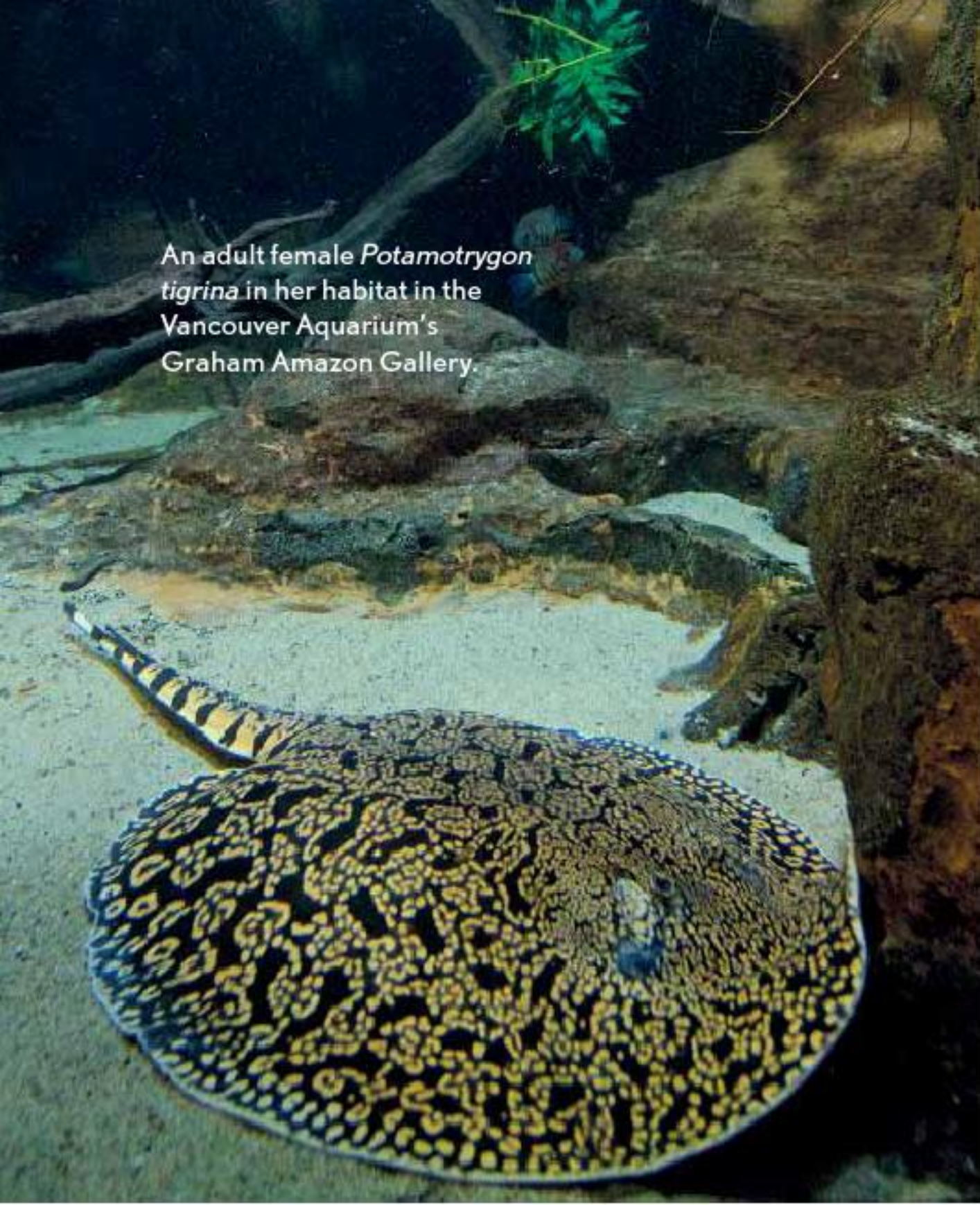
finally fed on plain smelt. To call these stingrays picky is an understatement.

With persistence over the years, I was able to introduce a wide variety of frozen seafood items to the diet of these stingrays, including smelt, chopped

Portrait of a *Potamotrygon tigrina*



An adult female *Potamotrygon tigrina* in her habitat in the Vancouver Aquarium's Graham Amazon Gallery.



trout, shrimp, clams, squid, Capelin, and even a commercially available gel diet. All three stingrays have grown to become large and stunningly beautiful specimens.

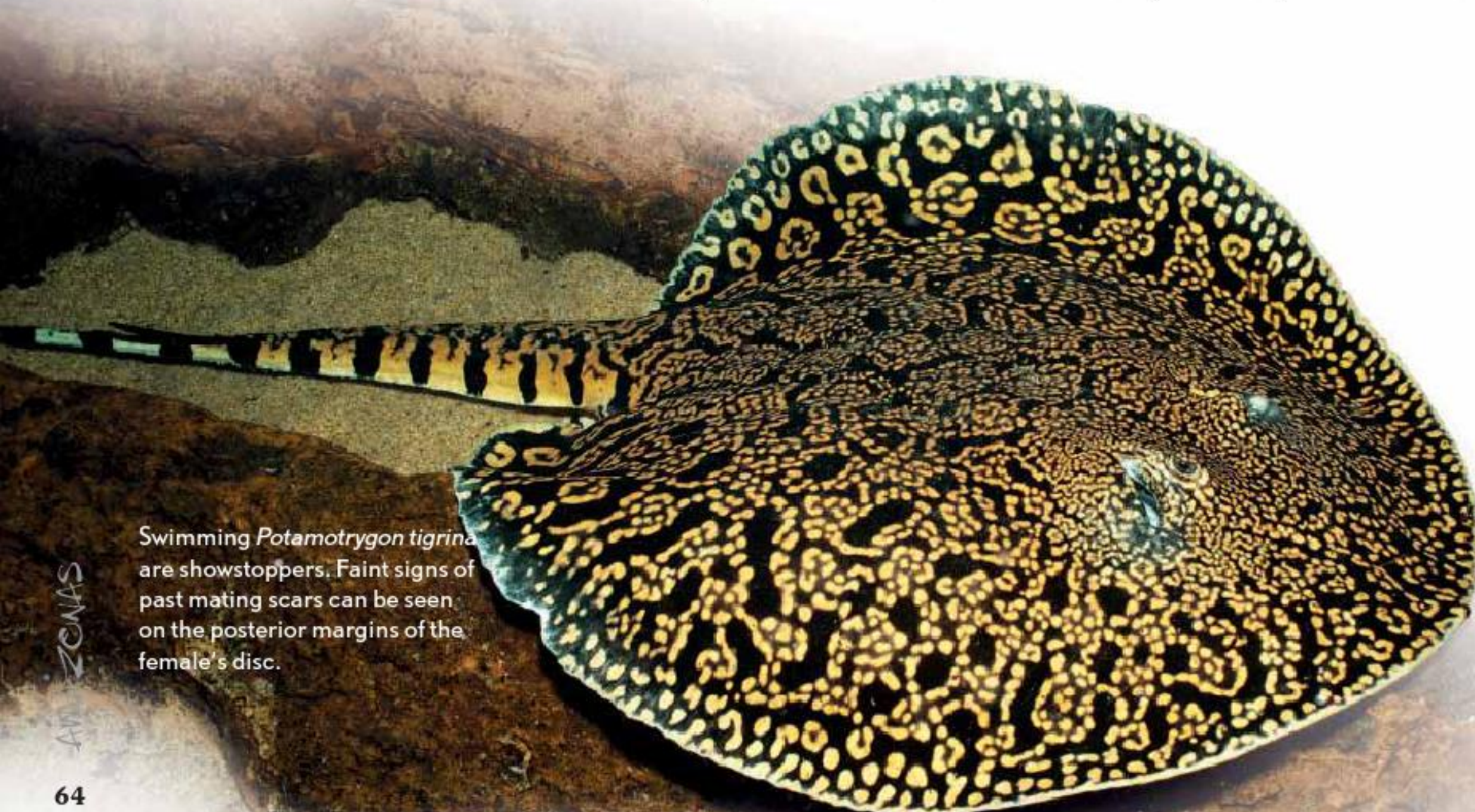
### The exhibit

Our stingrays are maintained in an 1,800-gallon (6,790-L) enclosure measuring 9.5 x 8 feet x 39 inches deep (2.87 x 2.39 x 0.99 m), with fine sand substrate and several waterlogged pieces of driftwood. There is also a darkened area in the back where the stingrays tend to spend periods of time resting during the day. They share the enclosure with a number of teleost tankmates, includ-

ing *Satanoperca leucosticta*, *Heros* sp. "Rotkeil," *Chalceus macrolepidotus*, *Hydrolycus scomberoides*, *Acanthicus adonis*, and a few other characin and cichlid species. I have never observed undesirable interactions between these species and the *P. tigrina*. The exhibit is filtered by a central system gravity sand filter, and a constant influx of soft, local fresh water keeps the system virtually free of nitrates or other nitrogenous wastes and just shy of neutral pH (6.8–6.9, with no measurable hardness). Temperature is somewhat variable but is typically maintained between 79 and 83°F (26.5–28.5°C) year-round. Photoperiod is 12/12.

### Mating activity

The first and only time I observed any mating activity in these stingrays was in mid-2006. The female was 17 inches (43 cm) DW and the male just slightly larger. While I suspect that most of the mating activity takes place at night when I am not present to monitor the animals, this mating event was observed at 9:00 A.M., after the lights had already been on for two hours. The male followed the female closely, back and forth against the wall of the exhibit, biting onto the right posterior margin of her disc. Eventually, the male modified his grip to bite an area centrally located on the right edge of her disc, and placed himself so that they were pressed together, ventral disc to ventral disc. While the claspers were not perfectly visible from my viewing position, it appeared they were moving, and that this is when fertilization took place. They then broke apart and rested in separate locations. The entire process lasted approximately 30 minutes. The male swam to the front of the exhibit, and I observed a small amount of white liquid pass from his claspers. I am unsure if this was the first incident of copulation, but I was able to record mating scars annually thereafter, usually in June or July. We used ultrasound to examine the female periodically but were unable to detect



Swimming *Potamotrygon tigrina* are showstoppers. Faint signs of past mating scars can be seen on the posterior margins of the female's disc.

any evidence of pregnancy.

I had been in communication with several other aquarium professionals who speculated that our *P. tigrina* female needed to attain a minimum disc width of 19.7 inches (50 cm) before successful reproduction could take place. The speculation was based on records of stillbirths or abortions in freshly imported or collected animals, as well as observations made with the first successful captive birth at Shedd Aquarium. I knew the female was approaching this size, so I hoped for a successful birth soon.

In November of 2008, we performed another ultrasound and confirmed that the female, now 18.9 inches (48 cm) DW, was pregnant. Unfortunately, in January of 2009 I found a single dead pup in the exhibit. It appeared that the pup had sustained some injuries, which I speculated had been inflicted by the male stingrays and were the cause of death. In December of 2010, we confirmed another pregnancy by ultrasound, so I removed both male stingrays from the exhibit, leaving only the female (19.9 inches/50.5 cm DW) in the exhibit. It soon became obvious that she was heavily pregnant by the vigorous movement and wriggling of the pups, as seen around the female's dorsal posterior area when she lay at rest.

### Success at last

On the night of January 17, 2011, after four months of gestation since I had recorded mating scars on September 17, 2010, the pups were born. It was not obvious at first, as it was difficult to see her clearly in the back of the exhibit, but she appeared to be thinner. Then, I noticed the two newborn *P. tigrina* pups in the sand. All I could clearly see were the last 2–3 inches (5–8 cm) of their long tails, blackish projections resembling fallen twigs. Finally, a successful birth! I retrieved the pups from the exhibit and introduced them to a specially prepared, dimly lit 124-gallon (470-L) holding tank behind the scenes. The two male pups were 5.2 inches (13.3 cm) and 5.1 inches (12.9 cm) DW at birth. Claspers were barely noticeable. A second successful birth on April 2, 2012, resulted in the birth of two smaller female pups: 4.6 inches (11.8 cm) and 4.7 inches (12 cm) DW. At these sizes, the pups typically have extremely long tails, and their total length at birth is around 11.8 inches (30 cm). At birth, their overall coloration is very pale beige, including the venomous spines. Their dorsal color pattern is not as complex



The author (left) and Vancouver Aquarium veterinary staff perform an ultrasound on a pregnant stingray. Water is an excellent conductor, so there is no need to move or anesthetize the fish.

and is more rounded and simple, lacking the intricate vermiculation, stark color contrast, and intensity they gain as they grow.

### Rearing the Pups

In both instances of successful reproductive events, the pups were born with full stomachs. The first fecal matter to pass was whitish in colour, indicative of their in utero diet of histotroph, sometimes called “uterine milk.” This is a protein- and lipid-rich uterine secretion produced by the mother’s trophonemata, structures in the uterine lining that nourish the developing young.

I offered the first food, live blackworms, one day after birth. The pups normally spent most of the day hiding in the sand, but became active at night, as evidenced by a number of small holes in the sandy bottom (from



*P. tigrina* pups make difficult photographic subjects because of their tendency to stay buried in the sand throughout the day.

searching for food) and the increasing quantity of darker-colored feces, resulting from feeding on the blackworms. As I could not observe the pups individually at night to ensure that they were feeding, I instead gauged this by how well rounded and plump the posterior disc area was. All the *P. tigrina* pups to date have remained plump and healthy on initial daily offerings of blackworms.

At about one week, I began to offer other food items, such as frozen *Mysis* shrimp, finely chopped smelt, squid, clams, and chopped earthworms. Each individual seemed to have its unique level of pickiness about the new food items. In both instances of rearing two *P. tigrina* pups, one individual was eager to try new food items, while the other consistently rejected new items. This reminded me that it is best not to make too many generalizations about species, particularly with highly intelligent animals like freshwater stingrays. It seemed that even in a generally picky species like *P. tigrina*, some individuals were more particular than others.

Once the pups were reliably feeding on blackworms, the daily regime was to first offer

food items they normally rejected, with the idea that they would be hungry and possibly try them. I offered at least two or three different food items throughout the day. At the end of the day, all leftover food was siphoned out, and I supplied either live blackworms or chopped earthworms. I felt it was important to wean the pups away from blackworms as soon as possible to prevent them from becoming “addicted” to them and preferring them to other, more nutritious food items.

Therefore, as soon as earthworms were regularly accepted, sometime between one week and one month of age, I discontinued offering blackworms. The tricky part with some of the individual pups was to convince them that something dead or frozen was indeed an edible food item. Some pups had no problem with this, but in other cases, new food items were so totally ignored that they were not even sampled. I suspect that because they are elasmobranchs, with the ability to detect the biological electricity of their prey items, anything not emitting such a signal may simply be considered inedible.

### Playing hard to get

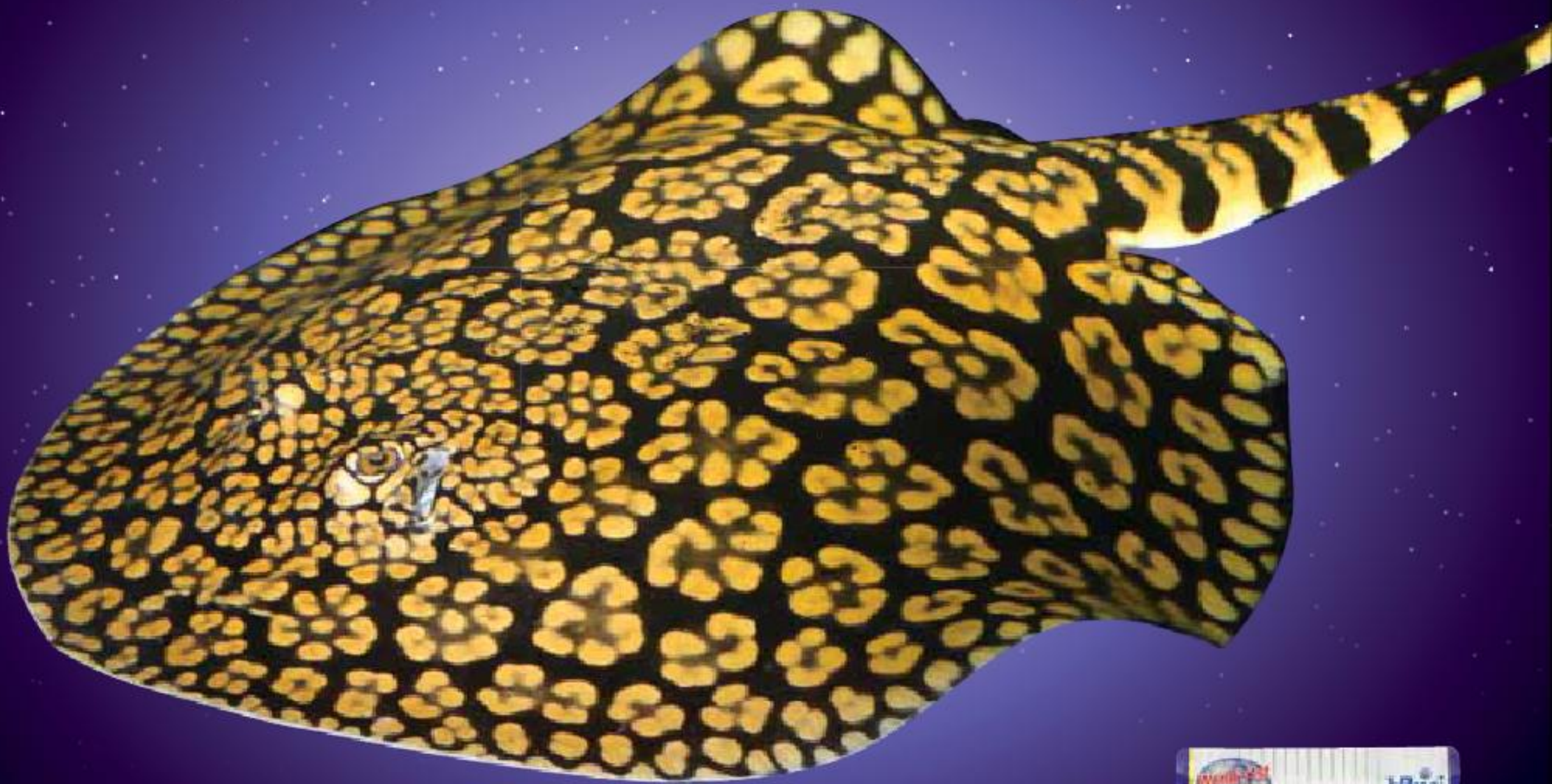
In such cases, I returned to my first lesson with *P. tigrina*. I changed only one factor at a time with regard to the



Above: Young Tiger Stingrays are progressively conditioned to eat frozen smelt by slowly diminishing (left to right) the quantity of earthworms.

At seven months of age, pups typically feed well on an assortment of offerings, such as gel diet and smelt.





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Left: Around 5–6 months, the venomous spine begins to turn black and a second one starts to grow.

food. Therefore, if the pup ate earthworms, it was now offered the same earthworms frozen. When this was successful, I did not offer any live food again until six months of age or older, when the pup was growing rapidly and was feeding voraciously and predictably. Another technique I used was “marinating”

other food items with chopped earthworm droppings. Sometimes this worked, but at other times they were wise to my tricks.

One recent pup was a really tough customer. All foods except frozen earthworms were categorically rejected. I decided to stuff sections of these earthworms painstakingly with smelt, creating what my colleagues and I referred to as “earthworm sausages.” At first, just as their mother did years ago, they picked out the smelt and rejected them via the spiracles. I did not give up, however, and placed an even smaller amount of smelt inside the earthworm pieces until it was accepted. Over the following days and weeks, I increased the volume of smelt until it poked outside the earthworm. When this was accepted, I decreased the amount of earthworm until what I offered more closely resembled an earthworm “napkin ring.” After offering these specialized food items for a month, the fussiest of the most recent *P. tigrina* pups began to eat smelt reliably with no earthworm at all. At this point, I did not offer earthworms again until other food items such as clams, squid, and even gel diets were regularly accepted.

### Growth and development

With all of the *P. tigrina* pups at the Vancouver Aquarium, it took approximately six months for the pups to eat a wide variety of foods. By this age, they had typically gained an average of 2.8 inches (7 cm) in disc width and their venomous spines had deepened in color, becoming almost black. At about eight months, a second venomous spine developed. At

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At 18 months of age, the pattern on the Aquarium's first *P. tigrina* pups began changing from wormlike to more speckled.

one year of age, the first pups were twice their disc width at birth. (One-year-old juveniles reach 27.5 inches/70 cm TL—what a tail!) It is also at this point that they really developed that deep golden hue and complex coloration they are so well known for. It seems the pattern continues to gain in complexity as they grow, expanding and filling in slowly but surely.

Compared to other freshwater stingray species I have worked with, such as *P. motoro* and *P. leopoldi*, *P. tigrina* are more skittish and less likely to become interactive. Although I have been able to train them to feed from PVC target poles, they still seem more wary of this than other freshwater stingrays. They seem to prefer to flee rather than strike when startled. They also seem to have a difficult time developing a skill seen in many captive stingrays—flipping food under their discs when it lands on top. These subtle but key behavioral differences may reflect some of their natural history or trophic niche in the wild, but further research on wild populations is still needed.

## Looking forward

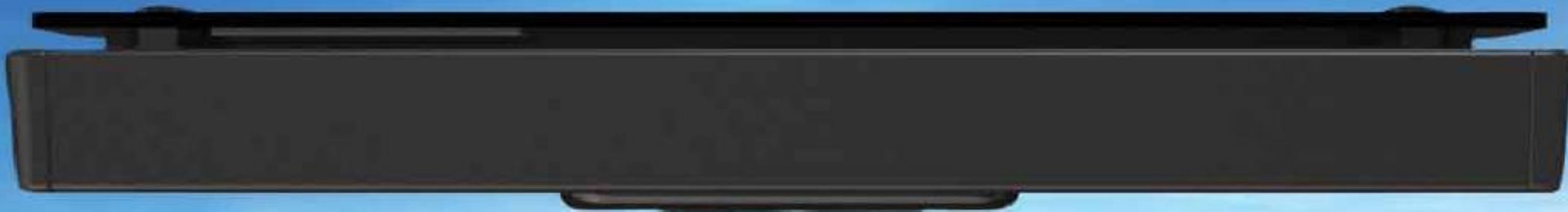
Freshwater stingray populations held in institutions accredited by the Association of Zoos and Aquariums (AZA) are part of a managed program that strives to manage and conserve species of concern, just one of over 300 such programs. To date, captive maintenance and reproduction of *P. tigrina* has not been as successful as with other priority species in this program. However, as we learn more about the unique requirements of this beautiful species, we will be better positioned to ensure the sustainability of a healthy and genetically diverse captive population, so that we may continue to learn from them in the future. 🐟

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This is probably an adult female "*Cichlasoma*" cf. *gephyrum*. Females seem to have fewer bright bluish dots on the body and head.

## "*Cichlasoma*" *ornatum* or "*Cichlasoma*" *gephyrum*?



article & images by Thomas Weidner • Within the "*Cichlasoma*" *festae* group, there are some robust South American cichlid species that have led a shadowy existence for many years. Then, in 2010, the export of these fishes was reinvigorated by exports from Colombia. But to what species do these newly imported animals belong?

In 2010, almost simultaneously, two German tropical fish importers brought in cichlids of the "*Cichlasoma*" *festae* group at different ages. At first OF-Aquaristik received only a few fry, but the 1.2-inch (3-cm) babies were far too small to identify to species level.

My first guess was that they were related to "*C.*" *ornatum*, but the location of origin, Río San Juan, was wrong for this cichlid. It is, however, home to "*C.*" *gephyrum*. According to the present state of knowledge, "*C.*" *ornatum* only occurs in the extreme south of Colombia, in the drainage area of the Río Patia, or even further south in the Ríos Durango and St. Javier in Ecuador. I bought

some animals and planned to wait until they grew larger to determine the species.

A short time later, Aquarium Glaser imported an 8-inch (20-cm) adult from the Río San Juan that looked just like the smaller fish and an equally large specimen of a cichlid that was nearly identically patterned but significantly more elongated and pointed. I acquired both animals.

### Species, subspecies, or morph?

"*Cichlasoma*" *gephyrum* Eigenmann, 1922 was originally described as a subspecies of "*C.*" *ornatum*. Eigenmann saw similarities to both "*C.*" *atromaculatum*, which as a juvenile is similarly elongate, and

Semi-adult  
"Cichlasoma"  
*cf. ornatum*,  
about 5 inches  
(13 cm) long.  
Depending on  
the individual's  
mood, the  
lower half of  
the body can  
turn almost  
completely  
black.



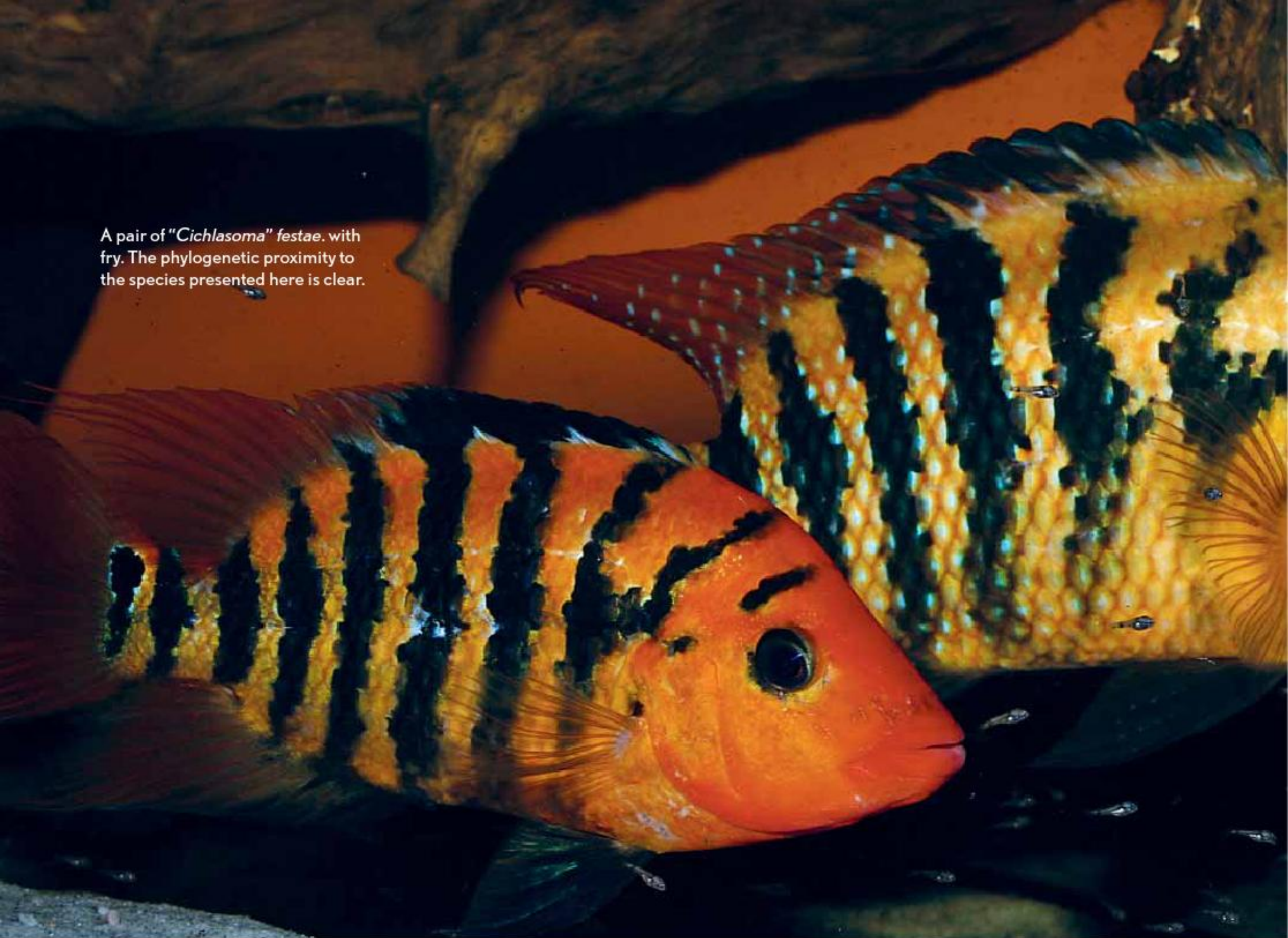
Adult male  
"Cichlasoma"  
*cf. ornatum*.



The head of this "Cichlasoma" *cf. gephyrum* looks much bigger than that of "Cichlasoma" *cf. ornatum*, and the body is also slightly more elongated.



A pair of "*Cichlasoma*" *festae*. with fry. The phylogenetic proximity to the species presented here is clear.



"*C.*" *ornatum*, so he chose *gephyrum* (bridge) as a species name. Today however, "*C.*" *gephyrum* is regarded as a distinct species.

I have decided to assign the more elongate adult cichlid to "*C.*" *gephyrum* because it is more similar to "*C.*" *atromaculatum*, both in behavior and in the head and body shape. It also shows a more predatory behavior than

the other adult and the juveniles, which I would assign to "*C.*" *ornatum*. Since I am not sure if they indeed belong to these species, I added the ever-popular cf. (Latin *conferre* = to compare) to both names.

We know of similar situations, for example with *Herichthys minckleyi*. We know that in this species, both fish-eaters and snail-eaters have evolved, and they differ in

"*Cichlasoma*" *atromaculatum*. The body and head shape more closely resemble "*C.*" cf. *gephyrum* than "*C.*" cf. *ornatum*.





### “Cichlasoma” festae: The Red Terror Cichlid

The archetype for the “Cichlasoma” festae group, the Red Terror is as notorious for its disposition as it is glorious in its full breeding pigmentation, seen at left.

Formerly known as *Heros festae*, this species is native to the Pacific drainages of South America in Ecuador (Rio Esmeraldas) and Peru (Rio Tumbes). An introduced population is said to be thriving (and terrorizing native fishes) in Singapore.

Males can reach a length of 20 inches (50 cm), females a maximum of 12 inches (30 cm). Even experts consider them a challenge to breed because they are so fiercely territorial and aggressive that deaths can occur during attempts to create pairs.

terms of body shape and dentition. However, both morphs are (still) considered the same species. Could my two “Cichlasoma” represent a similar phenomenon? Both forms have scales with dark centers on the flanks, so the flanks appear to be irregularly spotted. Both show an extraordinary ability to change color: the flanks can appear almost black, but shortly afterward they display black bars on a yellow background. However, the females of both species have significantly fewer spots in the head region, which is not necessarily a species characteristic.

#### Varying aggressiveness

The juveniles of “C.” cf. *ornatum* are pretty peaceful and do not fight particularly intensely, either amongst themselves or across species or genus boundaries. Over the past year I have kept four of the 1.2-inch (3-cm) imports in aquariums ranging from 132 to 185 gallons (500–700 L), in the company of other large South

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Surprisingly, this, too, is "*Cichlasoma*" cf. *ornatum*—this time in courtship coloration.

American cichlids. Four other animals up to 4 inches long (10 cm) shared a 66-gallon (250-L) aquarium with adolescent earth-eaters.

Later, I received two "C." cf. *ornatum* at a size of about 8 inches (20 cm), which adjusted to the community in a 238-gallon (900-L) aquarium. However, when I combined these two animals and the single "C." cf. *gephyrum* to see if they were simply different sexes of the same species, the "C." cf. *gephyrum* initially courted the "C." cf. *ornatum*, then threatened and pursued them. After that, the "C." cf. *ornatum* started hiding.

In the early days of their time together, the color of the "C." cf. *gephyrum* brightened and the base color turned to yellow, similar to "C." *atromaculatum*. Today, I keep the three "C." cf. *ornatum* and the single "C." cf. *gephyrum* together in the 238-gallon aquarium, and the three "C." cf.

*ornatum* pretty much ignore the "C." cf. *gephyrum*. Thus, I believe they are, in fact, two different species.

It should be noted that overall, my "C." cf. *gephyrum* is much more aggressive than my "C." cf. *ornatum*. In a 100-gallon (400-L) aquarium, this fish apparently pressured his relatives so that they felt increasingly uncomfortable, and only resumed their normal behavior after he was removed.

Today, I keep this group along with *Crenicichla cametana*, *Caquetaia myersi*, and a group of *Geophagus* sp. "Roraima" in a 238-gallon (900-L) aquarium with lots of roots and rocks, and this combination has worked well for several months. I would be happy if it was also possible to produce offspring in this setup. Strangely enough, neither I nor two other friends who received "C." cf. *ornatum* have been able to breed these animals. 🐟



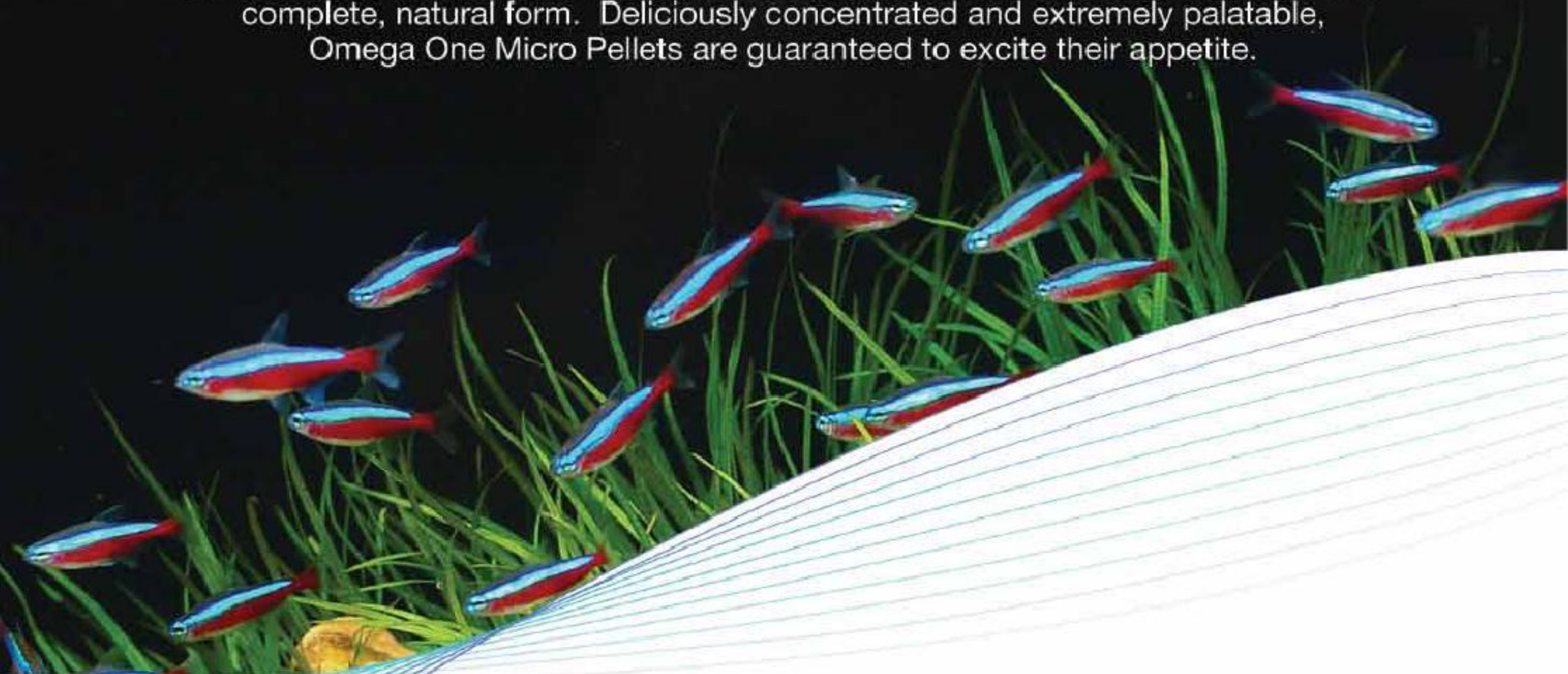
Females of both species sport dark spots in the middle of the dorsal, but depending on the fish's mood, they aren't always obvious.

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# A trip on the Rio Negro



*article & images by Juan Miguel Artigas Azas* • Our journey on the Rio Negro in Brazil took us from Barcelos in the state of Amazonas to the rapids of Arará in the state of Paraiba. As our boat, *Lo Peixe*, plied the waters of the tributaries, igarapés (creeks), and igapó (flooded forests), we saw many fishes that are familiar to aquarists. The fantastic scenery that surrounds this legendary blackwater river was equally impressive.

Three of my best friends gathered for this trip: Ad Konings, Pam Chin, and Patrick de Rham, who conceived and organized the expedition. Also traveling with us were Pierre Alain Leresche, Stephanie Urech, and Sylvain Ursenbacher from Switzerland. We arrived in early October in Manaus, the capitol of Amazonas. Our starting point was Barcelos, about 250 miles (400 km) to the northwest.

Exploring the Rio Negro by boat is a unique experience. When you gaze down into the water, it looks pitch

black. Blackwater rivers are very soft and acidic; the Rio Negro has a pH as low as 3.8 and an electrical conductivity of only 10  $\mu\text{S}/\text{cm}$ . The concentrations of sodium, magnesium, calcium, and potassium are very low. This has ecological consequences, and the fish density is relatively low. The water temperature during our trip was 81°F (27°C), and even warmer in the shallows.

The size of the Rio Negro is amazing. The main branch is over 3 miles (5 km) wide. Near the Anavilhanas and Mariuá Islands it is as wide as 18 miles (30 km),

These predatory catfishes, *Goeldiella eques* (Family Heptapteridae), hover over the bottom, waiting for suitable prey.



and that's at the end of the dry season! In the rainy season, the river is 18 miles wide even over long distances, and 400 miles (650 km) wide above Manaus. The slope of the Rio Negro is gentle—it drops only 20 feet (6 m) over a distance of 250 miles (400 km) between Manaus and Barcelos—but it flows relatively fast. The banks are lined with big trees that I estimate are about 100 feet (30 m) tall.

### Cumarú

The sand banks near the town of Cumarú are like nothing I have ever seen. On one side, a small group of islands made of fine white sand rose about 3 feet (1 m) above the calm waters. The tea-colored blackwater contrasted starkly with the white sand, creating a beautiful landscape. Near the shore, there were a number of

circular depressions about 3 feet (1 m) wide. Fishermen avoid these areas because they are created by stingrays, whose poisonous tail stingers are not to be underestimated. Accidentally stepping on one of these camouflaged rays can trigger an otherwise unlikely attack. The sting is extremely painful and can even be lethal in combination with an ensuing infection.

When we jumped into the water in the afternoon, we had our first encounter with the Boto, or Amazon River Dolphin (*Inia geoffrensis*). With its flexible neck and spine, it is adapted to hunt for fish and crustaceans in the igapó.

That night we caught some beautiful *Geophagus winemilleri*, *G. gottwaldi*, and one of my favorite fishes, *Osteoglossum ferreirai*. We found Pike Characin, *Acestrorhynchus microlepis*, here and all over the Rio Negro. With its



The thorny catfish *Amblydoras nauticus* is quite peaceful and feeds on small insect larvae.



Despite its excellent camouflage, we discovered this Dappled Whiptail Catfish, *Hemiloricaria melini*, at the bottom of Lake Quimeba.

sharp teeth, streamlined shape, and size (10 inches/25 cm), this is an impressive hunter of the open waters.

### Quimeba

Traveling up the Paduari, a left tributary of the Rio Negro, we came to the small village of Tapera, where the wooden houses are lined up along the shore. Many of them are built on wooden stilts to prevent the entry of floodwaters and to keep animals out.

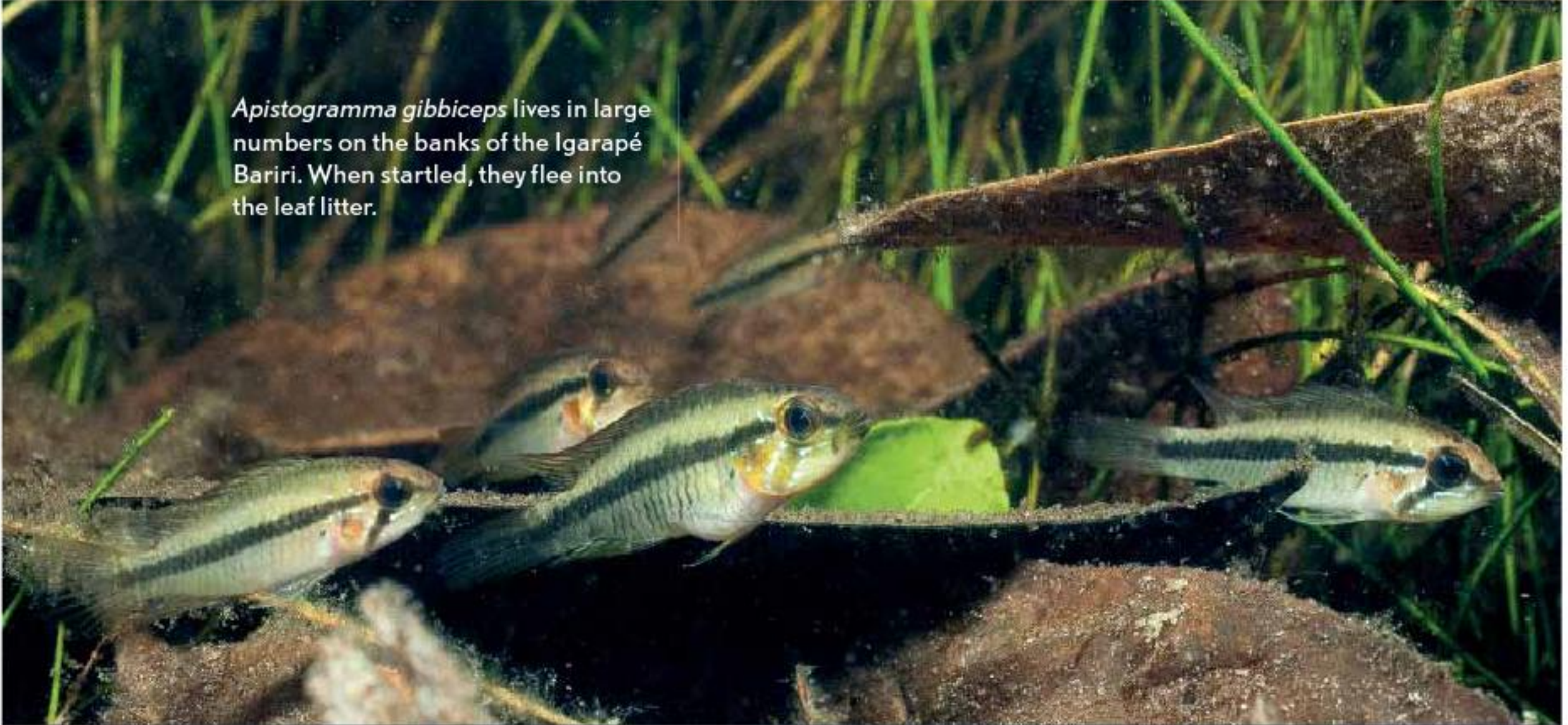
Lake Quimeba is beautifully situated and full of fishes. To get there we crossed a small igarapé in the forest, where we found an unusually marked species that turned out to be *Hemiloricaria melini*, the Dappled Whiptail Catfish. Its body and fins were beige, and from nose to tail the body was covered with irregular salmon-colored patches rimmed with black.

For the first time, I saw the Orinoco Eartheater, *Biotodoma wavrini*, under water. The yellow color of their





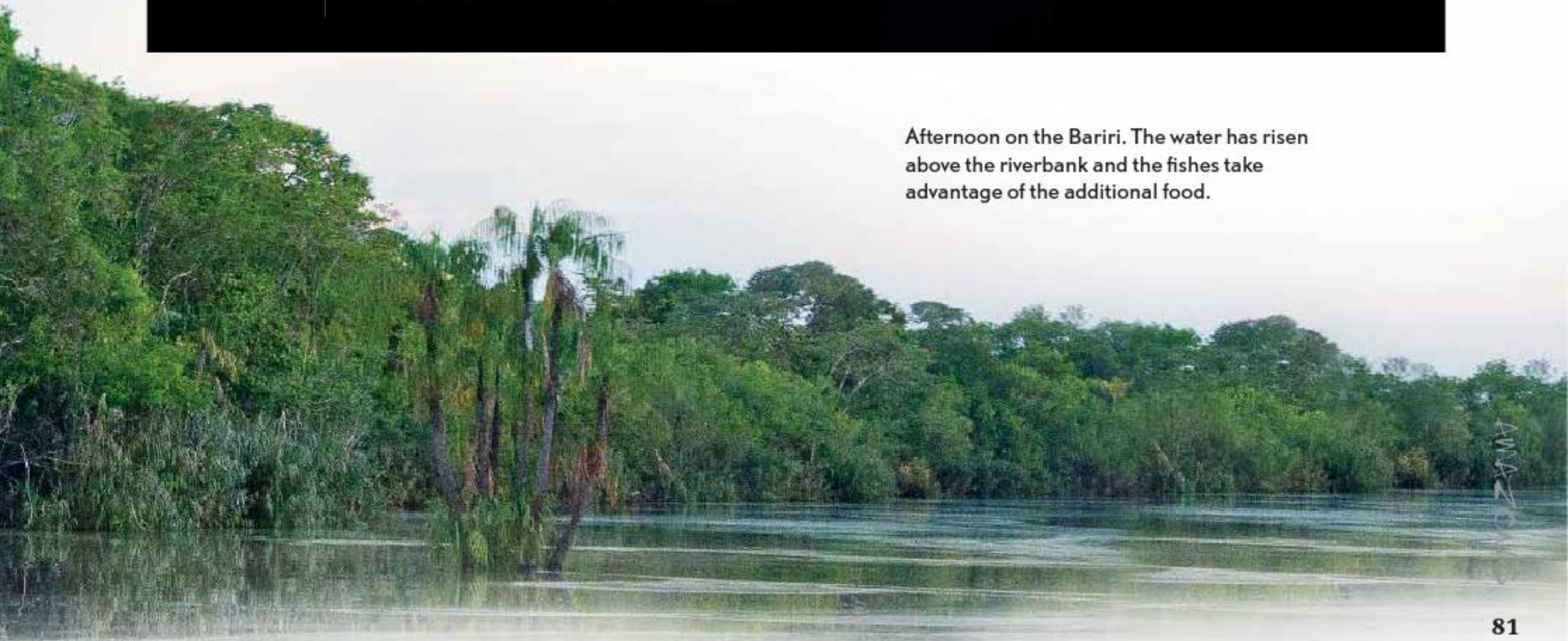
If you remain still, *Apistogramma pertensis* becomes curious.



*Apistogramma gibbiceps* lives in large numbers on the banks of the Igarapé Bariri. When startled, they flee into the leaf litter.



This Striped Pike Characin, *Boulengerella lateristriga*, is searching for prey in the twilight of the igapó.



Afternoon on the Bariri. The water has risen above the riverbank and the fishes take advantage of the additional food.

AMAZONIA



Chessboard Cichlid, *Dicrossus filamentosus*

fins is striking, but in the water of the Rio Negro it is hardly visible. With outstretched pectoral fins, these cichlids swim in a bouncing motion over the mostly sandy substrate. They are curious and sociable, but cautious.

Near Quimeba, *Apistogramma gibbiceps*, common in other locations, was replaced in large part by *A. pertensis*, which behaves similarly. The male *A. pertensis* has a slightly more elongated shape. A good distinguishing feature of the species is the striping pattern of the tail fin.

### Kwiuni

The calm waters of an igapó at the mouth of the Kwiuni west of Barcelos was one of the most beautiful places on this trip. The water was littered with yellow *Utricularia* bladderwort flowers. A large, shy Uaru Cichlid, *Uaru amphiacanthoides*, swam through the vegetation, unfortunately too fast to photograph it. This herbivore inhabits the calm waters of overgrown lakes, where it hides among plants. A *Biotoecus opercularis* sand cichlid, with its big yellow head and long body, was likewise too fast

for pictures. But I succeeded in photographing the males of *Dicrossus filamentosus*, which were quite frequent here.

While I was swimming among the trees in the igapó, where the water looked darker and redder, I was surrounded by several yellow spots that reminded me of fireflies. At first they kept their distance, but gradually they got used to me. When they got close enough, I could identify the fish based on their yellow and black spots in the front of the dorsal fin; they were Threadfin Acara, *Acarichthys heckelii*, one of my favorite cichlids. The filaments of the dorsal and caudal fins were as long as those seen on carefully reared aquarium animals. Unfortunately, the water was too red to take a good photo.

### Jufaris

On the Rio Jufaris, we were surprised to find a billboard that advertised computer courses. A little further on a giant otter appeared; although it withdrew into the water at first, its curiosity made it return to investigate us more closely. Quickly a second animal appeared. Then they barked at us,

The *terra firme* forest of the Rio Negro is never flooded.





A Wolf or Tiger Fish, *Hoplias malabaricus*, lurking and waiting for prey in the flooded forests of the Bariri.



I found this Porcupine River Stingray, *Potamotrygon hystrix*, in the igapó of the Rio Jufaris.



which we interpreted as an unmistakable request to leave.

In an igapó of the Rio Jufaris, I slowly approached a large Porcupine River Stingray, *Potamotrygon hystrix*, and was excited to get a closeup of the eyes, which were hard to detect in all the detritus because they were the same color as the body. I kept a vigilant eye on the tail stinger. I was very careful because I had seen in a video that showed how effectively these animals can hide—they can be virtually anywhere! In the midst of the vegetation I discovered a group of old acquaintances: Bleher's Rummynose Tetra (*Hemigrammus bleheri*), a really beautiful tetra when observed in its natural habitat. It is no wonder that this is such a popular aquarium fish.

### Ambe

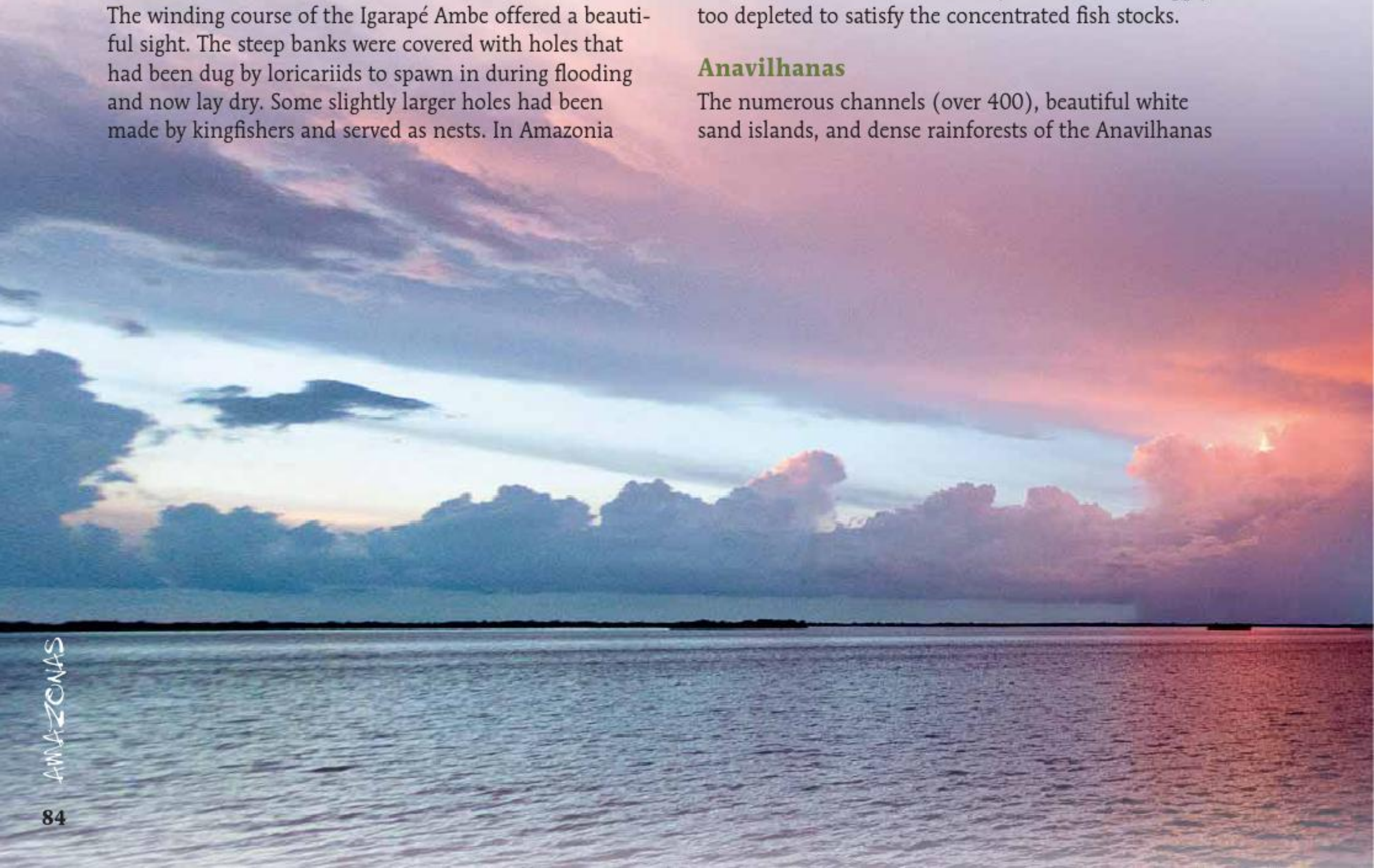
The winding course of the Igarapé Ambe offered a beautiful sight. The steep banks were covered with holes that had been dug by loricariids to spawn in during flooding and now lay dry. Some slightly larger holes had been made by kingfishers and served as nests. In Amazonia

there are four different species of kingfisher. They differ in size and have adapted to various fishes as food. In igarapés with steep banks, both catfish and kingfisher caves are common.

On the shore, we found fresh droppings and cat tracks that were bigger than a human hand. We figured they must have been made by a Jaguar, *Panthera onca*. At night, we tried to catch discus with small, long-handled nets. To discover the fishes, we used very strong lights. After all our efforts, we captured a single small fish. We were more successful with other species, such as cory catfishes. However, they are not easy to catch at night. In addition, we caught some angelfishes. Most of the fishes that we saw had piranha bites. At the end of the dry season, this is not unusual, since by then the food supply is too depleted to satisfy the concentrated fish stocks.

### Anavilhanas

The numerous channels (over 400), beautiful white sand islands, and dense rainforests of the Anavilhanas





Above: Angelfish seek protection and food in the dense tangle of branches just below the water's surface.

Left: *Pterophyllum scalare* in the igapó.



Sunset on the Rio Negro.



At the end of our journey, we came to the rapids of Arará.

Below: *Crenicichla notophthalmus* is frequently encountered in the clear waters of the Cachoeira Arará.



the animals that regularly gather at these islands to graze.

At night, from the boat, we could see hundreds of pairs of red lights on the water, reflecting the glow from the boat's lamps. These were the eyes of Black Caimans (*Melanosuchus niger*), the largest of the caiman species in the Amazon basin. The males can reach 16 feet (5 m) in length and weigh over 880 pounds (400 kg). Black Caimans hunt at night on land, where the large specimens prey on capybaras, tapirs, small anacondas, deer, giant otters, and, near human settlements, on pets. In the drainage area of the Rio Negro, Black Caimans are still quite common.

### Arará

The waterfalls at Arará are an impressive sight—the black water flows through white rock and white sand. Because of the gentle slope of the Rio Negro, there are few waterfalls. The clear water permits underwater photography and here you can find beautiful examples of Dwarf Pike Cichlids, *Crenicichla regani*, among the numerous *C. notophthalmus*. The females of the Rio Negro form of *C. regani* are characterized by two white-trimmed black eyespots on the dorsal fin.

The words of the early scientist Louis Agassiz are very applicable to the Rio Negro: "Go into nature. Touch it. Look at it with your own eyes." Every glimpse of the river's wonderful creatures, every landscape, every conversation with the local people, each moment is unique and informative. I thank my friends and companions on this trip and the crew of *Lo Peixe* for the wonderful experiences. 🐟

archipelago, now a national park, were one of the highlights of our trip. Once the rainy season begins, the grass begins to grow, and the gently sloping banks looked like freshly mowed lawns. In the evening a chorus of millions of frogs emanated from the grass, which can grow as high as 10 feet (3 m). The singers were males, trying to impress the females before spawning.

These areas are ecologically very important. Fishes find retreats and spawning areas here. The lower portion of grass decays and stimulates the growth of many microorganisms that serve the fishes and their larvae as food. Finally, the grass breaks loose in the strong currents and floats down the Rio Negro and the Amazon, spreading these organisms over the rivers' islands for hundreds of miles. Round-tailed Sea Cows, or Manatees, are among

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AMAZONAS

## CALENDAR

compiled by Matt Pedersen and Ray Lucas

## JANUARY 2014

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

**18** **CAFE Auction**  
**Champaign Area Fish Exchange**  
 Urbana, IL  
<http://www.champaignfish.com>

## FEBRUARY

**1** **South Carolina Aquaria Association**  
**2nd Annual Carolina Aquatics**  
**Tradeshaw**  
 Spartanburg, SC  
[carolinaaquaticstradeshaw.webs.com](http://carolinaaquaticstradeshaw.webs.com)

**8** **Aquamania (Feb 8–March 2)**  
**Capital Area Cichlid Association**  
 Gaithersburg, MD  
[www.capitalcichlids.org](http://www.capitalcichlids.org)

**10** **MAS Winter Auction**  
**Missouri Aquarium Society**  
 St. Louis, MO  
[www.missouriaquariumsociety.com](http://www.missouriaquariumsociety.com)

**15** **OCA Winter Auction**  
**Ohio Cichlid Association**  
 Strongsville, OH  
<http://www.ohiocichlid.com>

**16** **GCAA Swap Meet**  
**Greater Chicago Cichlid Association**  
 Hillside, IL  
[www.gcca.net](http://www.gcca.net)

**22–23** **Killifish Karnival**  
**35th Annual Show & Auction**  
**American Killifish Association Event**  
**Michiana Aquarium Society**  
 Niles, MI  
[www.michianaaquariumsociety.org](http://www.michianaaquariumsociety.org)

## MARCH

**1** **MCAS Auction**  
**Motor City Aquarium Society**  
 Madison Heights, MI  
[www.motorcityaquariumsociety.com](http://www.motorcityaquariumsociety.com)

**2** **ECC Spring Auction**  
**East Coast Cichlid Society**  
 Union, NJ  
<http://www.eastcoastcichlids.org>

**7–9** **Central Florida Koi Show 2014**  
**Central Florida Koi Show Society**  
 Orlando, FL  
<http://cfks.org>

**14–16** **35th Annual Convention**  
**Catfish Study Group**  
 Standish, Wigan, Lanc's, UK  
<http://Catfishstudygroup.org>

**28–30** **NEC 39th Annual Convention**  
**Northeast Council of Aquarium**  
**Societies**  
 Cromwell, CT  
[www.northeastcouncil.org](http://www.northeastcouncil.org)

**28–30** **CAFE 2014 Convention**  
**Columbus Area Fish Enthusiasts**  
 Columbus, OH  
<http://www.columbusfishclub.org>

## MAY

**15–18** **ALA 2014 Convention**  
**American Livebearer Association**  
 St. Louis, MO  
<http://www.livebearers.org>

**23–25** **2014 National Convention**  
**American Killifish Association**  
 Syracuse, NY  
<http://aka.org>

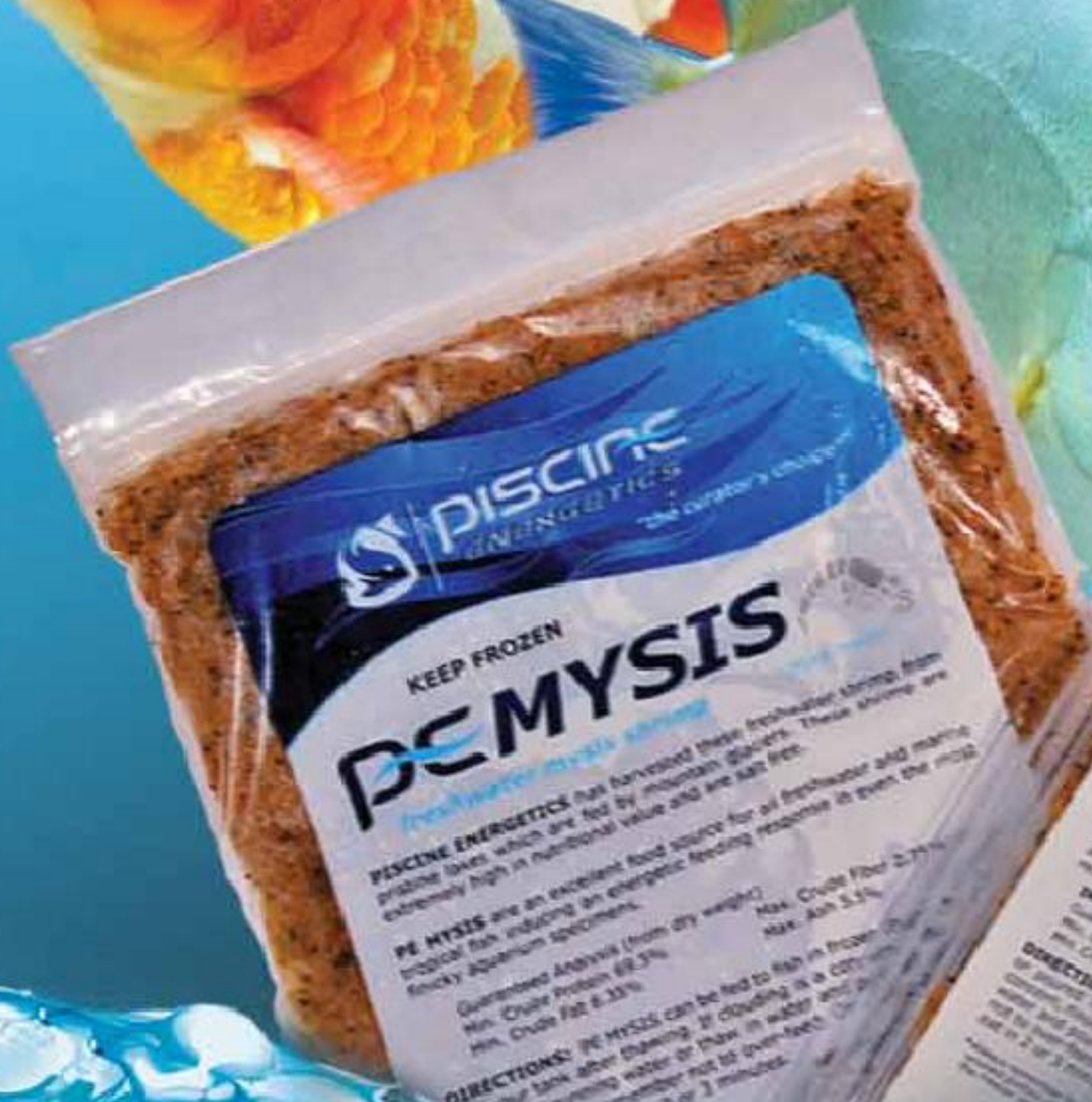
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Matt Pedersen: [matt.pedersen@reef2rainforest.com](mailto:matt.pedersen@reef2rainforest.com)

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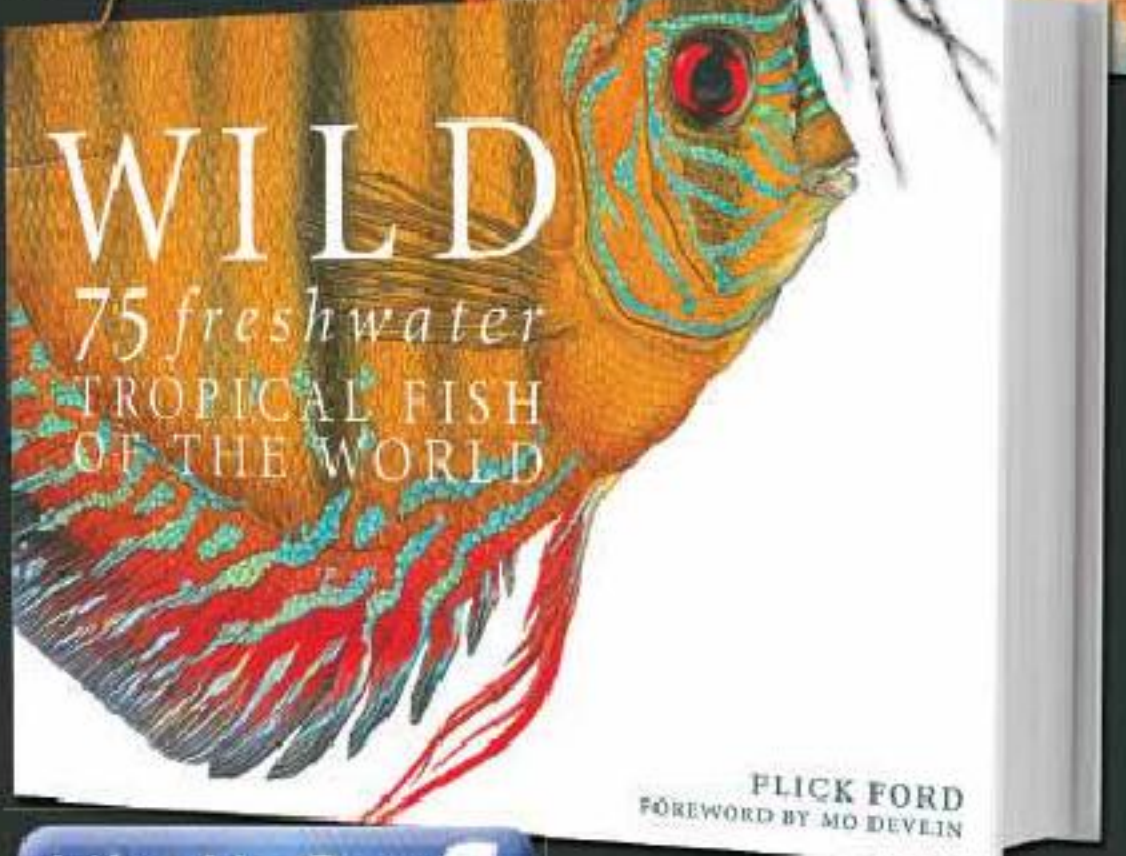
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❶ *CRYPTOCORYNE DEWITII* ❷ *BIOTOECUS DICENTRARCHUS* ❸ *KRYPTOPTERUS VITREOLUS* ❹ *PSEUDOMUGIL* SP. "TIMIKA" ❺ *PSEUDOGASTROMYZON FANGI* ❻ *TETRANEMATICHTHYS WALLACEI*



Submersed *Cryptocoryne dewitii* with spiraling spathe protecting a flower bud.

### *Cryptocoryne dewitii*

**1** | *Cryptocoryne dewitii* is one of the best marsh plants for the aquarium. It is a rare plant that can only be purchased from specialized shops or private water plant enthusiasts. I got my plants, along with other rare species, from the breeder Mr. Matali of Golden Leaf Aquatic Farm during Interzoo 2012. He had received his mother plants from Takashige Idei, one of the most knowledgeable experts on the genus *Cryptocoryne*. Idei has been traveling the marsh habitats of these plants for many years. He tracked down *Cryptocoryne dewitii* a few years ago on the island of New Guinea and collected some specimens.

All my crypts live fully submersed in medium-hard tap water under relatively low light. The original two plants have since turned into six via side shoots. In March 2013, one of the plants even produced a spathe, a bract sheath that encases a flower under water; for *Cryptocoryne*, this is a rather unusual event.

The aquarium has a substrate approximately 2 inches (5 cm) thick consisting of small to medium river gravel. The numerous shrimps clean the abundant vegetation, so there are no algae. Every two weeks, I change one-third of the water; no fertilizer is added.

I had good luck with another aquarium under somewhat different conditions. I received the plant in that tank from my colleague Stefan Reitel, who had previously grown it emerged. I suppose that the switch to a fully submerged life is the reason this specimen has yet to produce offshoots.

This light green plant with slightly bulbous leaves is a pretty addition for the aquarist who is looking for simple crypts. It is a pity that *Cryptocoryne dewitii* and other similarly easy-to-cultivate crypts are so difficult to obtain. Sadly, slow-growing plants are not popular for commercial culture, which is why the selection is limited to a handful of species.

—Hans-Georg Evers

### *Biotoecus dicentrarchus*

**2** | The hype about dwarf cichlids has mostly died down, but there are still some interesting species being imported. After years of not carrying it, OF-Aquaristik has again started to import specimens of the beautiful and rare *Biotoecus dicentrarchus* from Venezuela. This attractive and active dwarf cichlid is not shy and easily accepts frozen food after a short time. I recommend keeping them in pairs in a tank



Male *Biotocetus dicentrarchus*

measuring at least 20 x 12 inches (50 x 30 cm). It is important that the tank is not too densely planted and has large sandy zones. The animals are fully grown at a length of 2.4 inches (6 cm) and will reproduce with a little encouragement. Often, the main trigger is a reduction of the pH or the conductivity. The courtship of these animals is very exciting to watch. In particular, the male tries very hard to impress the female. Within three to four days after spawning, the fry hatch and begin to swim free right away, but they always stay close to the bottom and near their parents. Rearing these fish is fairly easy, and they can be fed small live food.

—Markus Kaluza

### Glass Catfish Redescribed: *Kryptopterus vitreolus*

**3** | Long popular in the aquarium trade, the Glass Catfish with its translucent body has been sold for decades under the species name *Kryptopterus bicirrhus*. A taxonomic revision in 2013 has given it the new species name of *Kryptopterus vitreolus*. Other closely related members of this group have a milky rather than clear appearance; they vary in body height and in the number of rays in the anal fin. Aquarists who want fishes with a glassy translucent body should now ask for *Kryptopterus vitreolus* in the trade.

Noteworthy are the distribution areas mentioned in

the description, which are all located on the Gulf of Thailand. Only Emmens & Axelrod (1966) commented on a location near Penang in Malaysia. Ng & Kottelat (2013) doubt this location and suggest an assessment.

My above-mentioned locality was a small, slow-flowing river, completely overgrown with water plants, in the south of Trang Province in southern Thailand. This river drains directly into the Andaman Sea. Its water parameters were pH 6.8 and 80  $\mu\text{S}/\text{cm}$ . This location suggests that the location near Penang might be correct and that the Glass Catfish, *Kryptopterus vitreolus*, occurs in all suitable habitats along the entire Andaman seacoast. Or could it be another species?

Glass Catfish must be kept in a group of at least seven animals to make them feel comfortable. I corrected my chosen tank size several times, until I arrived at 25 gallons (100 L). I love to watch the catfish hovering calmly between plants. These wild-caught catfish will accept any kind of live food.

—Jens Kühne

#### REFERENCES

Emmens, C.W. and H.R. Axelrod. 1966. *Catfish*. TFH Publications, Neptune City, NJ.

Ng, H.H. and M. Kottelat. 2013. After eighty years of misidentification, a name for the glass catfish (Teleostei: Siluridae). *Zootaxa* 3630 (2): 308-16.



Glass Catfish,  
*Kryptopterus vitreolus*

### New Blue-Eye? *Pseudomugil* sp. "Timika"

**4** | From the surroundings of the southern city of Timika in West Papua, New Guinea, some very pretty fish species have been introduced lately. Five of these are blue-eyes: *Pseudomugil ivantsoffi*, *P. paskai*, *P. cf. paskai* "Red Neon," *P. novaguineae*, and *P. pellucidus*.

As part of an import shipment in 2013 to Aquarium Dietzenbach, which came from Maju Aquarium on Java, there should have been some *P. pellucidus*, which I had ordered to rejuvenate my group. Unfortunately, these fish proved to be extremely frail and within a short time, they all died except for one male and one female, which I then studied more closely. Apparently, the supplier in Timika had found a new stream, because the male, at least, looks like a member of a new and undescribed species.

The female is almost indistinguishable from *P. pellucidus*, except that the anal and first dorsal fins are yellow. The male is really pretty, with scarlet red on the body and fins and a white margin on the lower tail lobe. The anal and second dorsal fins are much larger than in *P. pellucidus* and the second dorsal fin is a deep red.

This fish is very similar to *P. novaguineae*, but no red form of that species is known to exist.

According to Jeffrey Christian of Maju Aquarium, who was trying to obtain more animals after my inquiry, these blue-eyes are very sensitive to shipping. Nevertheless, let us hope that we will soon receive more animals to start some breeding attempts.

—Hans-Georg Evers

### A Chinese Hillstream Loach: *Pseudogastromyzon fangi*

**5** | Hillstream loaches are currently very popular in the hobby. Several species with quite presentable colors are regularly imported, including the loaches of the small genus *Pseudogastromyzon* from northern Vietnam and southern China. Lately, some aquaristically new species of fish from that area have arrived along with shrimps. The best known is *P. myersi*, a species that is imported every now and then from Hong Kong. I found it there in clear, shallow, and fast-flowing water with a temperature of 75°F (24°C) during the summer months.

*P. fangi* was described from the southern Chinese province of Guangdong, near the city of Guangzhou. The black dorsal margin, which is bordered by a broad yellow stripe, and the large black and yellow-striped pectoral and pelvic fins make this hillstream loach an attractive aquarium tenant. Aqua-Global imported a large number of these loaches in the spring of 2013, which quickly found customers. The successful propagation of this *Pseudogastromyzon* species, which reaches 2–2.4 inches (5–6 cm) total length, should certainly tantalize the specialized breeder. After all, other species in this genus have been bred in aquariums.

A shallow aquarium with river pebbles, strong current, and cool water temperature—below 75°F (24°C)—should provide a good start. Feeding them is easy; they accept flakes and tablets, frozen food, and live *Daphnia*.

—Hans-Georg Evers

### Wallace's Shoe Head or Driftwood Catfish, *Tetranematichthys wallacei*

**6** | The South American family of driftwood catfishes (Auchenipteridae) includes some species that bear a striking resemblance to a piece of wood (to some keepers, an old shoe!), even in its behavior—hence the popular names. If you feel the popular L-plecos are too colorful and hectic, why not try these phlegmatic and always-hiding cats! The three species of the genus *Tetranematichthys* are

*Pseudomugil* sp. "Timika," male



*Pseudomugil* sp. "Timika," female





*Pseudogastromyzon fangi*

best described as a mixture of a leaf and a piece of wood. I recently saw some *Tetranematichthys wallacei* at Pier Aquatics that, with their beautiful reddish brown color, comprised the decoration in an otherwise barren dealer tank.

These fish rely entirely on their camouflage, and only take up food when they feel absolutely undisturbed—usually during the night. They are ambush predators and opportunists that eat insect larvae and smaller fish. They get about 8 inches (20 cm) long.

As with all Auchenipteridae, reproduction happens via internal fertilization. The first rays of the anal fin in males are modified into a copulatory organ. In addition,

adult males have an extended dorsal fin, which is carried erect. Fertilized females usually scatter the eggs after a few days and provide no further care of the young. *Tetranematichthys wallacei* is the only species of the genus that is imported. It lives in the upper Rio Negro and upper Rio Orinoco. So far, there is no information on successful reproduction in the aquarium. Whether these animals scatter their eggs or even provide some form of brood care is not known. That may be because they are barely noticeable in store tanks, so usually only experienced aquarists discover them. Camouflage is everything for these fish!

—Hans-Georg Evers



*Tetranematichthys wallacei*,  
Wallace's Shoe Head Catfish



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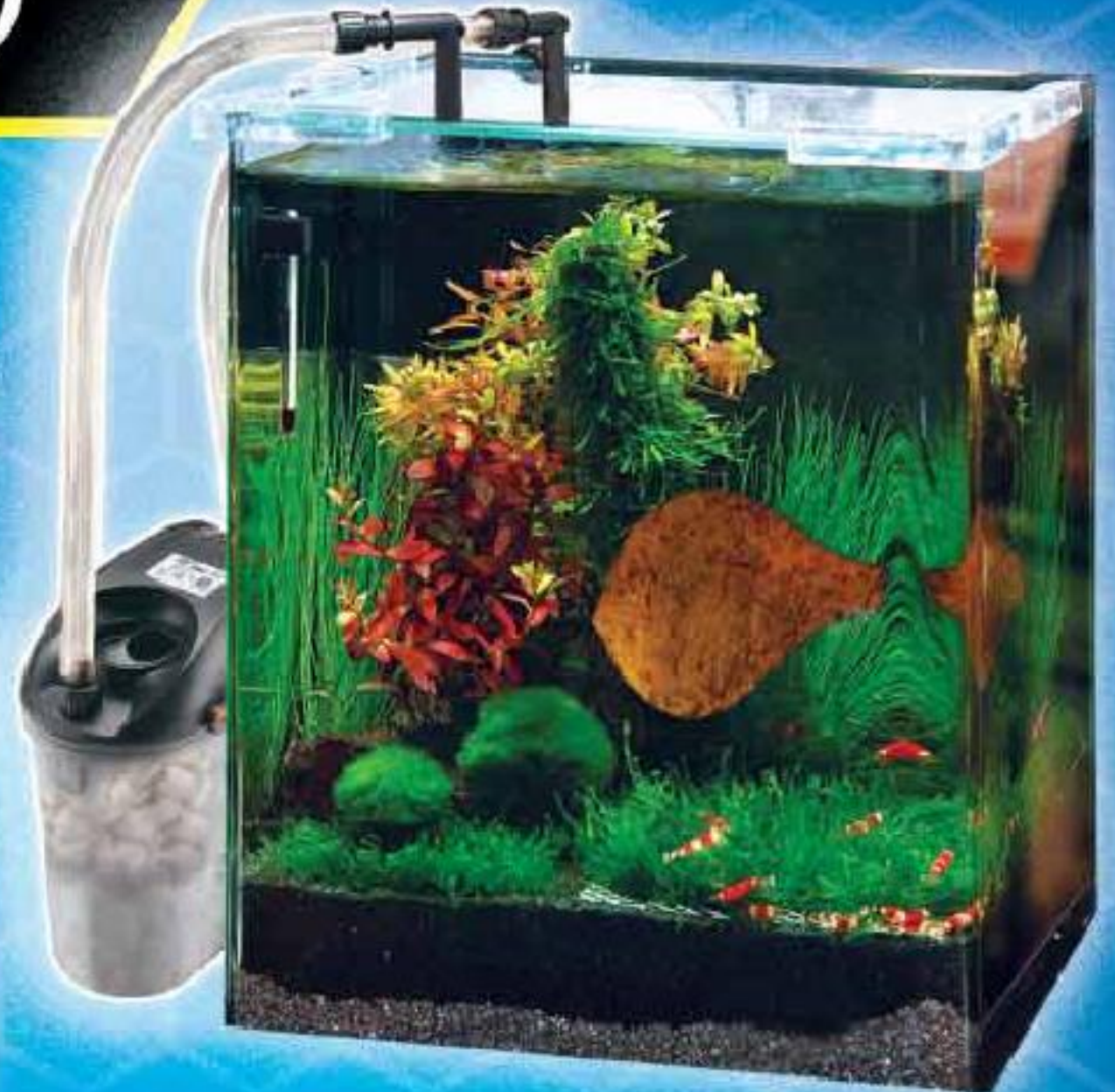
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