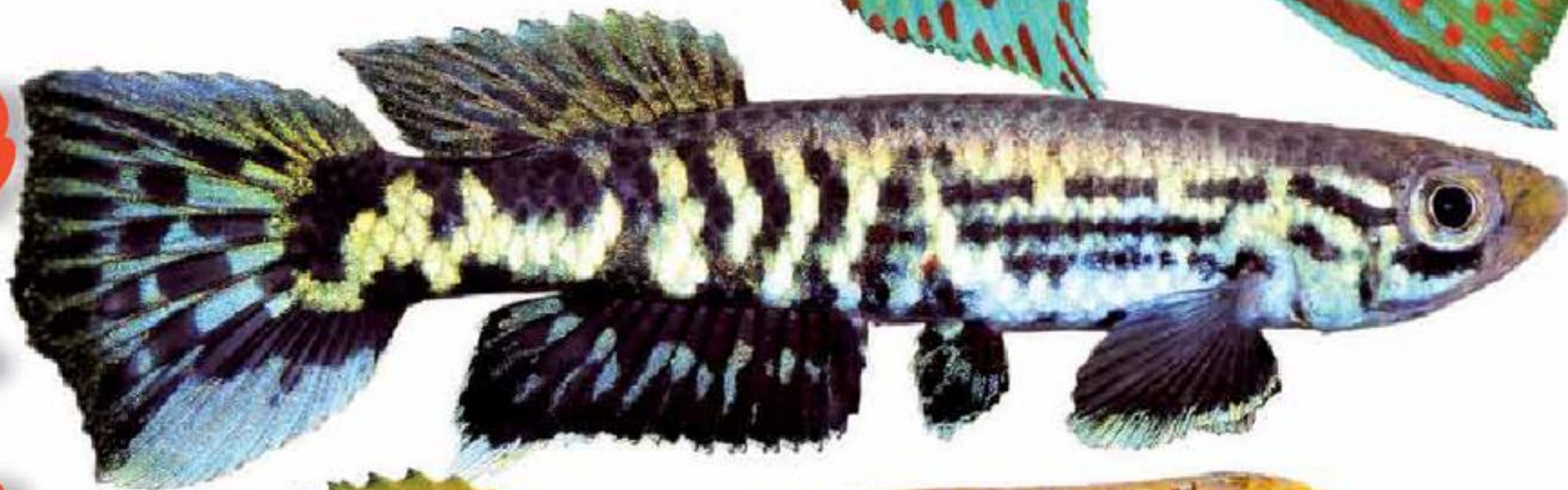


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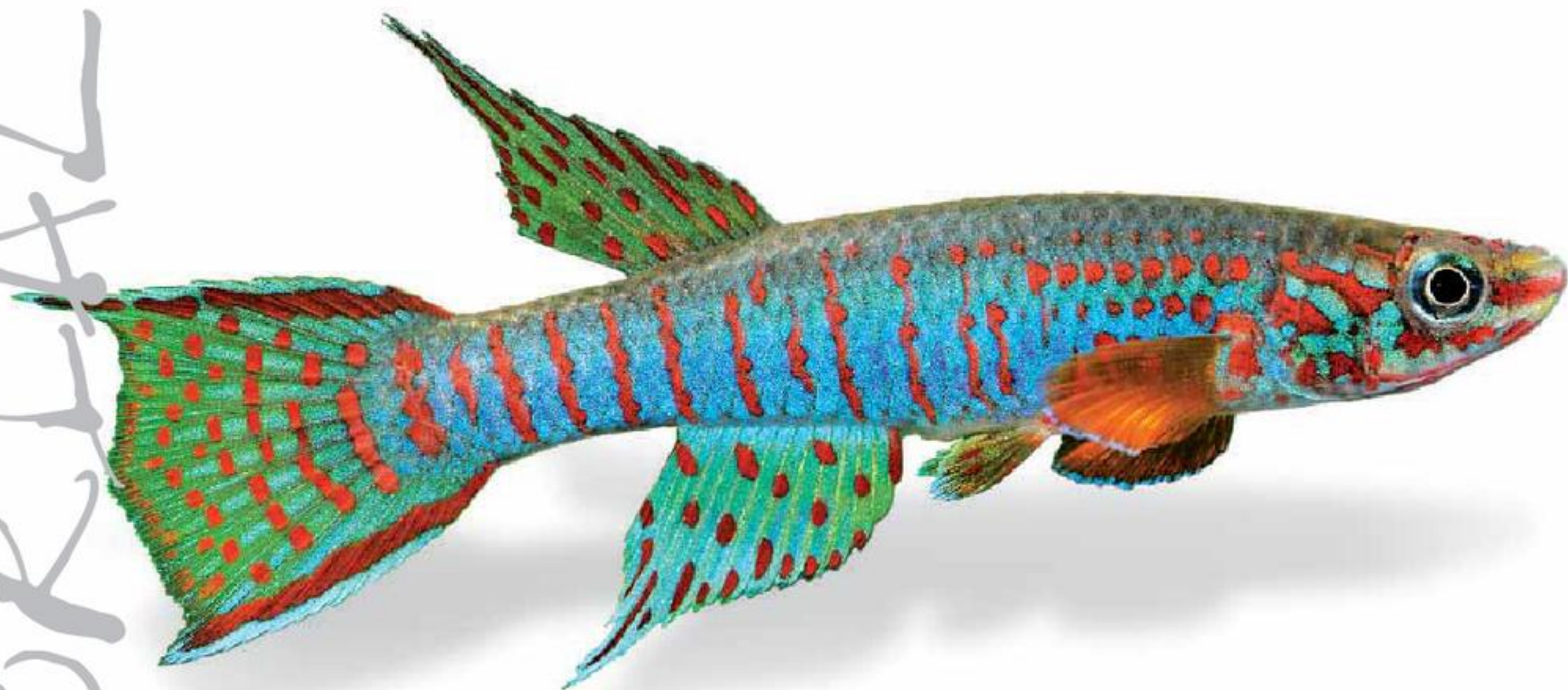
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## Dear Reader,

Fishes from Africa play almost no role in the modern aquarium trade today, unless they come from the famous Rift Lakes. This, of course, was not always the case. During my youth, the cichlids and the small but very vibrant killifishes of Central and West Africa were quite popular.

Killifishes were kept then—as they are now—mostly by specialists, but they were more commonly mentioned in the literature and more often seen at shows and auctions. Today, killifish enthusiasts appear to operate much more under the radar. However, our knowledge about these colorful dwarfs is vast, and scientists and amateur enthusiasts have contributed much to it in recent years.

One of our editorial board members, Olaf Deters, is very active in this sphere of interest, so it was just a matter of time before we chose killifishes as a cover theme. We have intentionally focused on the genus *Aphyosemion* because the name is well recognized and there are many new and exciting insights to tell you about. An African cover story is quite unusual for us, but I hope you enjoy this peek beyond the usual horizon.

When water plant enthusiasts gather, the question of lighting will almost always come up sooner or later. We have wanted to report on this topic for some time, and in this issue we include hands-on articles on the ever more popular LEDs. In the marine hobby, this technology is already widespread and fast becoming an accepted technology.

For a catfish buff like me, the breeding report on the Pac-man Catfish, *Lophosilurus alexandri*, is truly

a highlight. Similarly exciting is the story about the Blue-Eyed Pleco, which is certain to start a lively discussion—and not just among catfish followers.

When I look over this new issue, with its many interesting stories that should excite a diversity of true



addicts, I cannot stop grinning! It is amazing what both hobbyists and scientists have to report. Quite the opposite of predictable, fishkeeping is far better than reality television for most of us. I would much rather spend my time in the fish room than turn into a dazed sofa spud.

Enjoy the issue, and happy fishkeeping!

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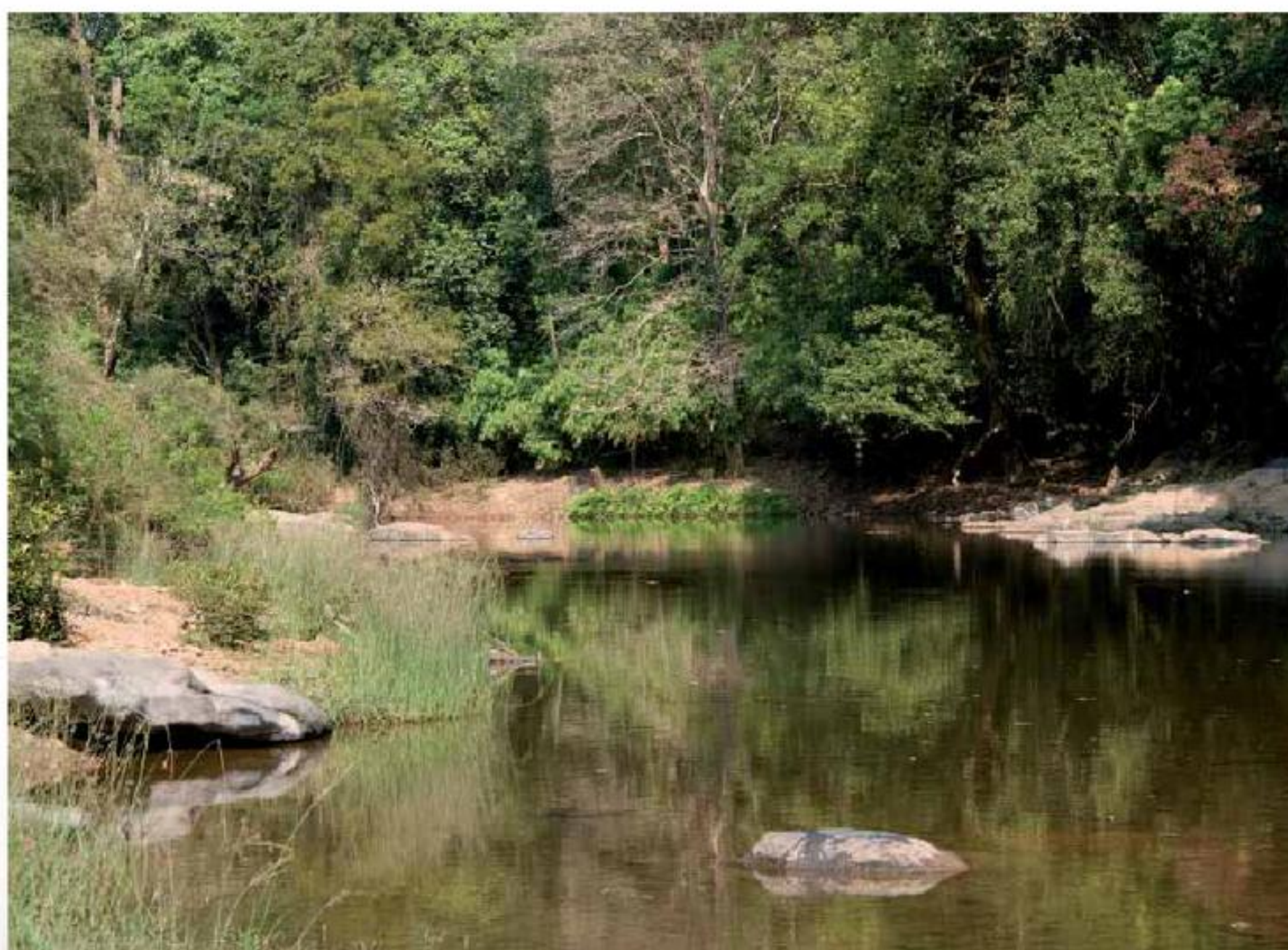
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• article and images by Ralf Britz

## Three new fish species from Southern India



The fish fauna of the so-called Western Ghats, a mountain range that extends parallel to the west coast of India over a distance of 1,600 km (1,000 mi.) from Maharashtra in the north to Kerala in the south, is considered one of the best-studied ichthyofaunas in this country. Sykes (1839) and Jerdon (1849) published the first monographs of the freshwater fish fauna, which were followed by those of Day and Hora and their co-workers. A recent compilation by the International Union for Conservation of Nature (IUCN) listed 290 different species of fishes (Dahanukar et al. 2011). The best-known species of the Western Ghats is the Red-Line Torpedo



Right: Type locality of *Pangio ammophila*

Below: *Pangio ammophila*





*Pristolepis  
rubripinnis*

Barb, *Puntius denisonii*. Other popular species found there include *Carinotetraodon travancoricus* and *Pristolepis marginata*. While on a short collection trip with Indian colleagues in different river systems in Karnataka and Kerala, we were able to collect several new fish species, which we have described in the past few months. A big surprise for us was the discovery of a second Indian *Pristolepis* species, *P. rubripinnis*, which differs significantly from the known species *P. marginata*. We were able to capture a number of specimens of this fish, which has beautiful orange fin fringes, at night in the Pamba River. We hope that this species will soon be imported, because it is a very pretty fish.

In some recently published Indian publications, a second *Pristolepis* species, *P. fasciata*, was mentioned; however, this species is native to Indonesia. Whether the fish called *P. fasciata* in the Indian literature is potentially identical to *P. rubripinnis* could not be clarified due to the lack of reference specimens.

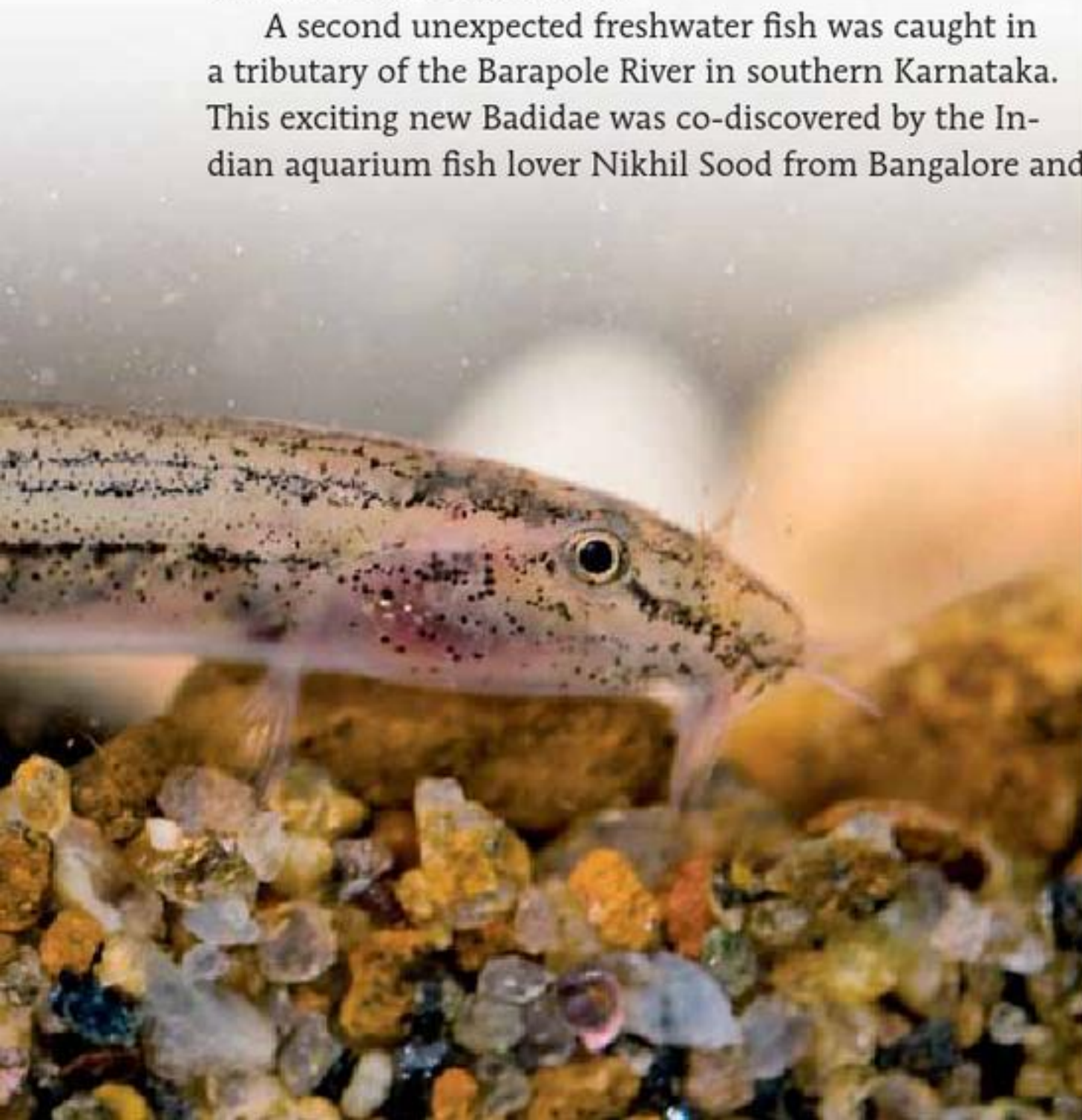
A second unexpected freshwater fish was caught in a tributary of the Barapole River in southern Karnataka. This exciting new Badidae was co-discovered by the Indian aquarium fish lover Nikhil Sood from Bangalore and

his German friend Benjamin Harink. Harink reported about it on the forum of the IGL (International Society for Labyrinth Fishes). Sood took us to the location and we were able to capture a number of these chameleonfishes in a few hours. The river was up to 10 meters (33 feet) wide and 2 meters (6.5 feet) deep. Large stands of aquatic plants such as *Blyxa*, *Lagenandra*, and *Cryptocoryne* were present. The new species was hidden, mainly in leaf litter that had accumulated in the shallower areas, and could be shaken out of the roots along the riverbank.

During our research to describe the species, we discovered that Francis Day, one of the fathers of Indian ichthyology, had already collected this fish, but he believed it belonged to the taxon *Dario dario*. There were also some specimens collected by Day, said to be from “Wynaad,” in the collection of the Natural History Museum in London, which, together with the newly collected animals, served as the basis for the description. For completeness, it should be mentioned that in June 2010, a group of Indian aquarists caught the same (or a very similar-looking) species in the Sita River, part of the Kaveri River system. Rahul Kumar pointed that out to me on the [Indianaquariumhobbyist.com](http://Indianaquariumhobbyist.com) forum.

Interestingly, the new *Dario* shows some features usually found in *Badis* species, such as the striking caudal peduncle spot, which has led to the species name *Urops*. This trait, however, is an ancestral trait and of no use in determining the relationship. The total absence of the lateral line, various lateral line pores in the head region, and the lack of gill rakers on different gill arches clearly place the species *D. urops* in the genus *Dario*, since these are all derived features.

Compared to other Badidae species, *Dario urops* is not exactly the most colorful of species, but it will surely fascinate fans of chameleonfishes. It remains to be documented how *Dario urops* propagates—like *Badis* species, via parental care by the male in a nest, or as egg scatterers in dense vegetation without parental care, like other *Dario* species. Aquarists still can contribute meaningfully



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Type locality of *Dario urops*



Male of *Dario urops*

in this respect. Nikhil Sood maintained these animals successfully for several months in a cool aquarium with faintly moving neutral and soft water, a sandy bottom, and a lot of leaf litter.

The third new species from the Western Ghats that we found in our nets was a new *Pangio*. We named it *Pangio ammophila* because of its lifestyle. The handful of specimens of this small, scaleless *Pangio* that we captured were buried in the sand of the Kumaradhara River. Because of its plain appearance it is unlikely that it will make it into the aquarium fish trade.

Another very unusual *Pangio* species has been described from the Western Ghats. *Pangio goaensis* is known not only from Goa but also from several rivers in Kerala, in the south. This *Pangio* is spectacularly striped; apparently, no pictures of live specimens were taken.

Our small-scale collecting trip to southern India has shown that this supposedly well-known part of India still holds many surprises, and with a little luck, a few of them might make it into the hobby. 🐟

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*Betta mahachaiensis* from Samut Sakhon; most populations have a rounded caudal fin, although the population in the first description has a pointed tail.

• by Jens Kühne & Chanon Kowasupat

## *Betta mahachaiensis*: a brackish water *Betta*



Ever since its recent discovery, many aquarists and scientists have known this brackish water fighting fish by the name *Betta* sp. “Mahachai.” The name refers to the type locality southwest of Bangkok. Although other names were considered, to avoid confusion *Betta mahachaiensis* was chosen.

*Betta mahachaiensis* Kowasupat, Panijpan, Ruenwongsa & Sriwattanarothai 2012 differs from other fighting fishes of the *Betta splendens* group in having two parallel, vertical, bright green to bluish green stripes on the gill plates. The eversible gill membrane is red-brown, brown, or black and has no red spots. The body base color is dark brown or black. The iridescent body scales give the fish its characteristic appearance.

The shiny blue-green fin membranes contrast with the brown-black dorsal, tail, and anal fin rays. The caudal fin lacks markings. The brown-black pelvic fins have a blue-and-white first dorsal ray and bluish-white tips.

The species is distinguished from other similar types of the *Betta splendens* group mainly by DNA studies. For further information, refer to Sriwattanarothai et al. 2010 and Kowasupat et

al. 2012. According to DNA analysis, *Betta splendens* is the closest relative of *B. mahachaiensis*.

### Brackish water swamps

*Betta mahachaiensis* lives in brackish water habitats west of Bangkok and in Sakhon Nakhon province, in pH values of 6.87 to 7.8 and a salinity of 1.1 to 10.6‰. When Panitvong introduced the species as *Betta* sp. “Mahachai” in 2002 on his Internet portal, siamensis.org, experts were surprised to learn that a *Betta* species could permanently settle in a brackish water habitat. *B. mahachaiensis* was initially known only from the government district Mahachai in Samut Sakhon and differed from local *B. splendens* forms. But Panitvong failed to mention that populations of *B. imbellis* from southern Thailand are also adapted to live in brackish water habitats.

The main habitat of *B. mahachaiensis* is the Mae Nam Klong, which flows as part of the Mae Nam Chin system in Samut Sakhon into the Bay of Bangkok. The Mae Nam Chin forms a marshy delta in which the salt-tolerant *Nypa* palm grows. These swamps are exposed to the tides that affect the great Mae Nam Chin, as well as

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**Habitat of *Betta mahachaiensis*.** The animals live between the *Nypa* palm trees and build their foam nests in the leaf axils of plants.

the Chao Praya River all the way to Nonthaburi, about 80 km (50 mi.) inland. The *Nypa* palm is found along all of these rivers and forms the habitat of *B. mahachaiensis*.

The habitats of *B. mahachaiensis* are periodically flooded by salt and fresh water. They very rarely dry up completely. During rainy periods, the swamps are diluted so much that the residual amount of salt is barely perceptible at 3 grams per liter (12 g/gal.). Peaking at 13 g/L (~50 g/gal.), this concentration is tolerated by the fish only for a short time. The optimum salt concentration seems to be between 3 and 7 g/L (12–28 g/gal.).

One of us (JK) found a high density of *B. mahachaiensis* individuals in freshwater streams near their inflows into the marsh. In Samut Sakhon there are freshwater habitats of *B. splendens* immediately adjacent to the brackish water habitats of *B. mahachaiensis*, but no mixing or hybridization of the species was observed.

*Betta mahachaiensis* will struggle to survive in the future, because the known distribution areas are being swallowed by the giant metropolis of Bangkok. However, there are other, yet unconfirmed habitats where this species might be found. Besides the Samut Sakhon province already mentioned, these probably include Samut Songkhram, Samut Prakan, and the southern parts of Nonthaburi west of Bangkok, where there are proven populations. The sporadic finds in Samut Prakan along the Mae Nam Chao Phraya south of Bangkok require confirmation.

### Aquarium care

How does *B. mahachaiensis* differ from other members of the *B. splendens* group in terms of care? Do you need to set up a brackish water aquarium for this

fish? No, not necessarily. One of us (JK) has already been keeping *B. mahachaiensis* for about five years. Some strains are kept permanently in fresh water without any noticeable impairment. Any treatment for disease symptoms should include salt. For prophylaxis, a small amount of added salt is recommended.

I cannot confirm that the proliferation of *B. mahachaiensis* depends on the salt concentration. The species builds foam nests and spawns readily in brackish water as well as in fresh water. These fish seem to react to intermittent warm and cold periods such as occur in Bangkok; they go through extremely fertile periods and then stretches of time when they show no signs of reproduction. We recommend trying to

breed young adult animals, three to seven months old. The females in particular have to be sexually mature, which they indicate with a white genital papilla. You can set up the aquarium as an underwater jungle with dense plants, roots, rocks, and clay caves. Many water lilies, *Cabomba*, *Vallisneria*, rushes, *Hygrophila*, horn ferns, and mosses tolerate brackish water well. 🐟

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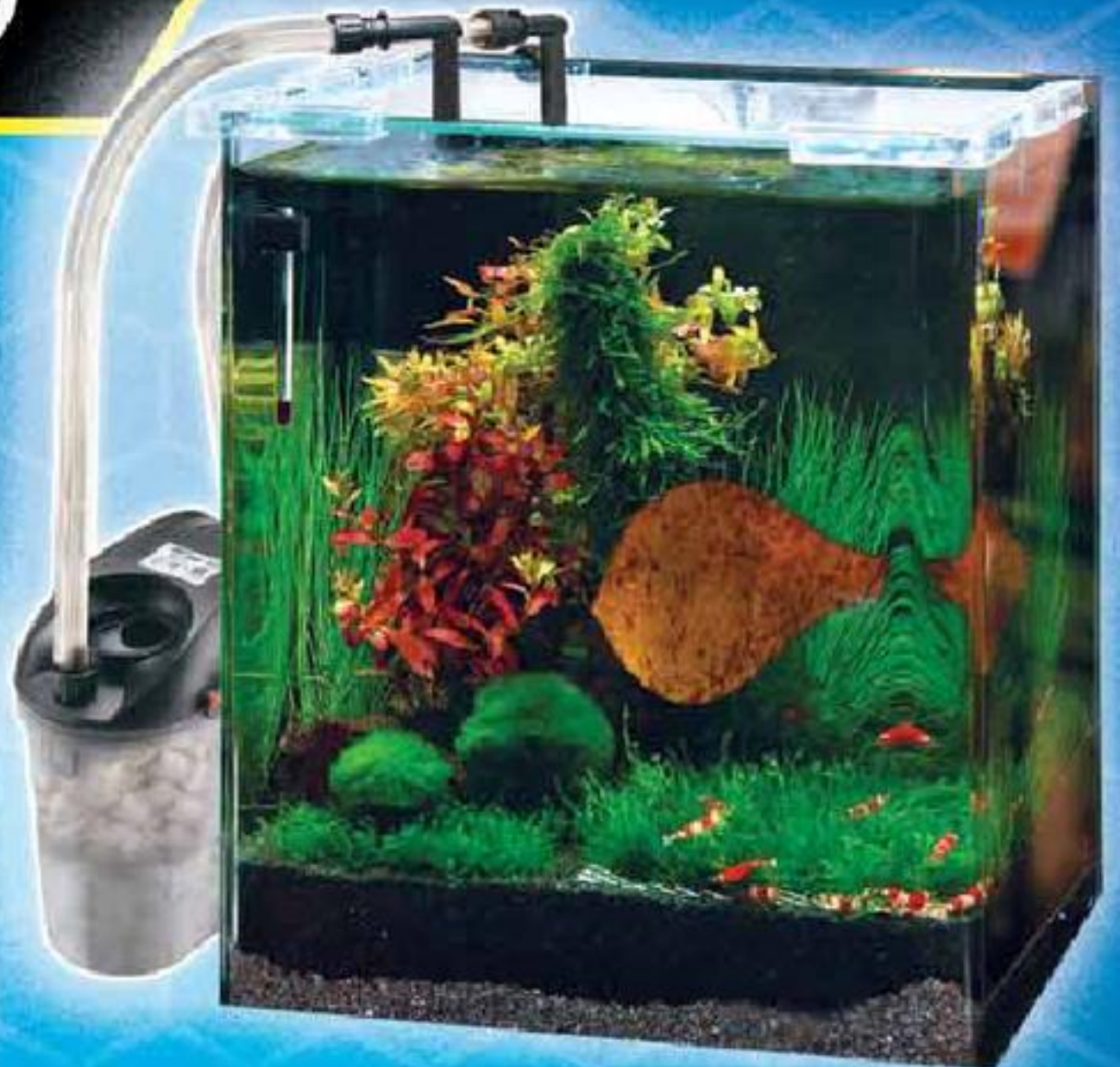
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# A Mexican Crayfish for Nano Aquariums

*Cambarellus patzcuarensis*  
"Orange": "berried" female  
carrying eggs under abdomen

*Text and images by Rachel O'Leary* • The Dwarf Orange Crayfish, *Cambarellus patzcuarensis* "Orange," is a petite and colorful crustacean that is not as well known to freshwater aquarists as it should be, but makes a sassy and active addition to a nano aquarium. Some crayfishes and "mini lobsters" can be destructive; this species has proved safe with plants, fishes, and other invertebrates.

In its wild form, it originates in Lake Patzcuaro, about 38 miles southwest of Morelia in Central Mexico. It is thought that the first orange offspring originated from a pair of hobbyists from the Netherlands in the late 1990s. They started becoming available in the United States several years later, and are casually referred to as CPO.

*Cambarellus* is a diminutive species, reaching around 1.25 inches (3 cm) at the largest and averaging about 1 inch (2.5 cm). Its native water is relatively cool, averaging about 72°F (22°C), and is moderately hard. These crayfish do not require a heater, but because of their size, any intake on a power filter should be covered with a prefilter sponge.

CPO have an average lifespan of two years, and warmer temperatures accelerate their growth and breed-

ing. Adult crayfish molt about twice a year, and young crayfish generally molt every three to four weeks until they hit maturity at about 0.7 inch (1.75 cm). They are fairly easy to breed. The male pins the female to the substrate and then places his sperm packets near her seminal receptacle. In a matter of days to weeks, she will molt and then produce from 20 to 50 eggs, which she attaches to her pleopod and covers with a protective mucus. The female carries the babies, even after hatching, until they are ready to venture out on their own. The adults do not prey on healthy young, so the survival rate is high.

Feeding is no problem—the crayfish readily take most prepared or gelatinized foods. Specialized feeding is not required for the young, although like all invertebrates they are sensitive to water quality, so care should be taken not to overfeed. They do well with a varied diet with both meaty (live or frozen worms and pellets designed for bottom feeders) and herbivorous foods (vegetables or algae-based foods), and appreciate having leaf litter for grazing. Enriched foods containing bio-pigments such as carotenoids will help maintain bright color.



Small size and relatively peaceful disposition make this an ideal nano-tank invertebrate.

While peaceful to other inhabitants, these crayfish can threaten each other, especially after molting, so ample hiding places or cover should be provided utilizing plants, small pieces of stacked driftwood, or clay or PVC caves. A pair can easily live in a 5-gallon (20-L) tank or be part of a larger, peaceful community of small fishes and invertebrates. 🐟



This crayfish, which resembles a miniature lobster, exhibits interesting behaviors and will reproduce in the aquarium.

**Planted Aquarium Set-up Phase 2: Establish biological filter.** Inoculate the system with the specific beneficial microorganisms that will maintain a low-waste system, as well as encourage rapid and lush plant growth.



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Wild-type *Enneacampus ansorgii* collected by Ted Judy in Gabon.



This new captive-bred red form is now reaching the aquarium trade.

• by Matt Pedersen

## Arriving soon: Tank-raised African Freshwater Pipefish

The African Freshwater, or Dwarf Red Snout Pipefish, *Enneacampus ansorgii*, is exotic and rare enough that even expert aquarists assume it is more at home on a coral reef than in a clear freshwater stream 100 miles from the ocean. Now this sometimes brilliantly pigmented little species is being bred in captivity and is starting to enter the aquarium trade.

Husbandry accounts suggest that wild specimens are certainly difficult to keep alive, generally requiring live foods such as brine shrimp, blackworms, *Daphnia*, cyclops, and even the fry of livebearers. Wolfgang Löll makes a compelling argument that live glassworms are the best food for pipefishes such as *E. ansorgii* because they survive for several days in the aquarium and will tolerate slightly brackish water.

Aquarium literature, where this fish was formerly known as *Sygnathus ansorgii* (Boulanger, 1910), generally suggests that the inclusion of salt is helpful for this species, although it is clear that some populations of the species have no contact with anything remotely close to a marine environment. A general rule is to house them in a small species tank in slightly brackish water or a .5-percent sea salt solution. Their reported range includes the Ogooue River of Gabon, Cameroon, and Equatorial Guinea. (American aquarist and award-winning breeder Ted Judy reports collecting males brooding eggs in pure, freshwater river conditions in Gabon.) They produce relatively large offspring.

In March of 2013, Segrest Farms in Gibsonton, Florida, announced the arrival and almost immediate sell-out (within 24 hours) of captive-bred *E. ansorgii*. These fish came in at a 3–4-inch (7.5–10-cm) size, which is close

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to the maximum adult size of 5–6 inches (12–15 cm) and were not produced by Florida or Asian fish farms, as many aquarists suspected, but actually made their way to North America from the Czech Republic via a small-scale

specialist breeder.

While this certainly isn't the first time this species has been successfully bred in captivity, this commercial availability represents a potential shift in our perception of the species. Just as captive-bred marine seahorses are infinitely better suited to captive foods and life in an aquarium, these captive-bred *E. ansorgii* were feeding on frozen Cyclops (CYCLOPEEZE®), and might be weaned to small, high-protein pellet foods or potentially even flake food. Truly, commercially viable captive-bred specimens may well redefine this species.

Segrest's Mike Tuccinardi suggests that "it's unlikely they'll be a regular stock item, but it wouldn't be out of the question to see them in some of the more specialized local fish stores across the country over the next few months. We are sold out right now, but we'll be bringing in more soon." He adds, "As for care, treat them as you would their saltwater cousins—avoid boisterous or aggressive tankmates, give them lots of cover, and feed them frequently."



#### ON THE INTERNET

[http://diszhal.info/english/livebearers/en\\_Syngnathus\\_pulchellus.php#ixzz2NbnQTyG5](http://diszhal.info/english/livebearers/en_Syngnathus_pulchellus.php#ixzz2NbnQTyG5)

<http://www.iucnredlist.org/details/full/167999/0>

<http://www.aqualog.de/Aqualog/news/web90/Seite11-13e.pdf>

#### Correction

The images accompanying the article, *Dicrosis maculatus*: Breeding the Checkerboard Cichlid by David Magid (AMAZONAS, Mar/Apr 2013, page 60), were taken by Noah Magid, not David Magid. AMAZONAS regrets the error.



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Male Black Ruby Barb,  
now known as *Pethia*  
*nigrofasciata*

## New names for old friends

*Hans-Jürgen Bäselt* • Nothing is as constant as change. This applies especially to the taxonomy of fishes, and earlier this year some familiar barb species from India and Sri Lanka were caught up in a sea of revisions. Pethiyagodha et al. revised the large “dumpster” genus *Puntius* and divided it into several newly established genera. Nine species of the former *Puntius filamentosus* group were placed in the genus *Dawkinsia*. The Melon Barb (formerly *Puntius fasciatus*, now *Dravidia fasciata*) was renamed and put together with four other species in the genus *Dravidia*. The third new genus, *Pethia*, was erected to include some very popular species, such as *Pethia conchoni*, *P. padamya*, *P. ticto*, and many more. *Pethia nigrofasciata*, known to many as the Black Ruby Barb, belongs in the genus as well. 🐟

The Melon Barb is now  
called *Dravidia fasciata*.

The Filament Barb  
*Dawkinsia filamentosa* was  
reclassified as well.



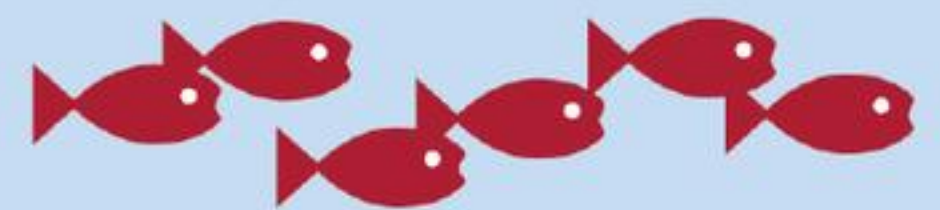
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Killifish gems in the genus *Aphyosemion* from the Congo River basin, in the second-largest rainforest on earth.

# *Aphyosemion* in the Congo Basin

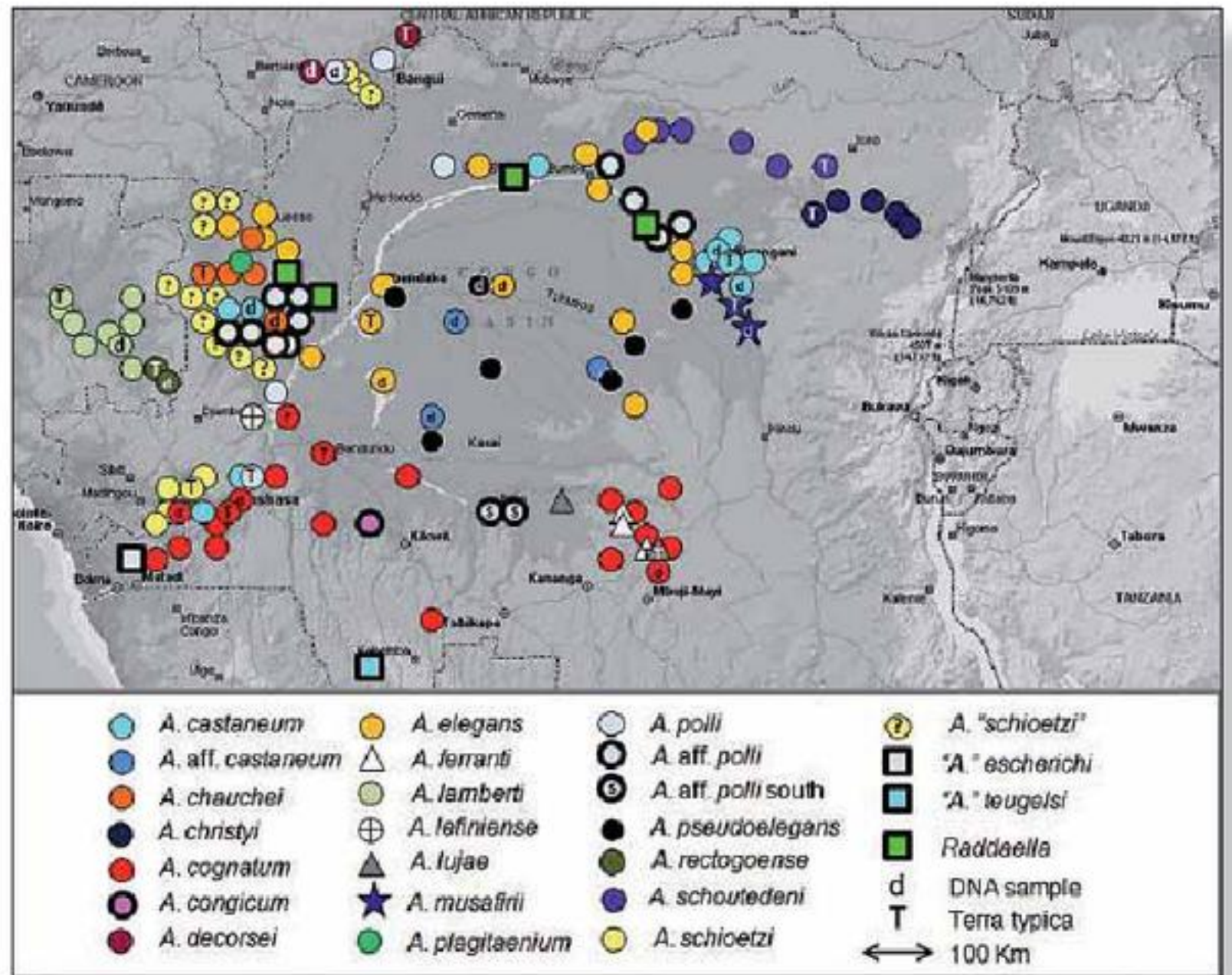


by Jouke van der Zee & Rainer Sonnenberg • African killifishes are some of the most coveted and beautiful of tropical fishes, but they are found in a place so vast, untamed, and fraught with violence that they are neither collected nor studied as frequently as many enthusiasts would like. Our interest in these fishes has focused on the genus *Amphyosemion*, which is very likely an assemblage of more or less related species groups.

The Congo, 2,717 miles (4,374 km) long and up to 755 feet (230 m) deep, is the deepest and second-largest river in Africa, and in terms of drainage area and water flow the second-largest river in the world, after the Amazon. Its drainage encompasses not only the two Congo states (Congo Republic and Democratic Republic of the Congo, or DRC) but also parts of Angola, Burundi, Cabinda, Cameroon, Rwanda, Zambia, Sudan, Tanzania, Uganda, and the Central African Republic.

The Congo already existed when the dinosaurs ruled the earth, although at that time it still emptied into the Indian Ocean. The Rufiji in Tanzania is possibly the former lower course of the ancient Congo river. During the Pliocene (around 1.8–5.3 million years ago) the East African highland plateau came into being and the flow of the ancient Congo in an easterly direction was blocked. Traces of former links to the east can still be detected today: depending on water level, the East African Lake Tanganyika still empties in the direction of the Congo via the Lukuga, and there is evidence that the Malagarasi, for example, used to be part of the Congo drainage.

After the blocking of the eastern lower course, the Congo rainforest could no longer drain away its water, and in time a vast lake developed in central Africa. It is thought that by one to two million years ago the mountains separating the lake from the Atlantic Ocean had been eroded to such an extent that a link between the inland sea and a westward-flowing river



Above: The map shows the distribution of the *Aphyosemion s. l.* species in the Congo Basin.

Right: Dr. Emmanuel Vreven, ichthyologist at Belgium's Royal Museum for Central Africa (RMCA), with his assistant. You need more than a net to collect fishes in the Congo.



Left: Location for *Aphyosemion christyi* in the Okapi Wildlife Reserve.



"*Aphyosemion*" *labarrei* from Nenga Kibuka, Ngufu River (AVD 2011).



"*Aphyosemion*" *labarrei* from Kingembe, Inkisi River (AVD 2011).



*Raddaella batesii* from Equatorial Guinea (EQG 06/2).

came into being. From then on the lake emptied westward from Malebo Pool to the Atlantic Ocean via its current lower course. But perhaps there were already earlier outlets in the direction of the Atlantic further to the north, for example via the Ogooue. There are still many unanswered questions to be researched here.

The remains of the ancient lake can still be found in the central Congo Basin, for example, Lake Tumba and

Lake Mai Ndombe. The surrounding areas are very swampy and difficult to access.

### Hard-to-Reach Fishes

In terms of fish collections, the Congo Basin is one of the least explored regions on Earth. This is mainly due to the immense size of the basin, the lack of infrastructure, and the very unstable political situation. Systematic study of the fish fauna of the Congo began in the colonial period; the works of Belgian zoologist George Albert Boulenger are particularly worthy of note. After 1960, the end of the Belgian colonial period, many fish collections were made by Belgian biologists and missionaries.

Nevertheless, large parts of the basin have never been scientifically studied. Aquarists, especially killifish specialists, rarely travel the eastern and southern Congo Basin. In the 1980s, Heiko Bleher explored Lake Fwa, in the drainage of the Kasai and the middle Congo. In 1985, Dutchman Jan Pap and two Germans, Winfried Stenglein and Wolfgang Grell, visited the northeastern part of the Democratic Republic of the Congo (DRC). This is probably one of the best documented collecting trips. The western part of the Congo Basin has been collected only in 1978 by Huber and in 1991 by a Dutch-Belgian team consisting of De Waegeneer, Vlym, and Van der Berg. By contrast, other African countries, such as Cameroon and Gabon, have been visited many times by aquarists in the past four decades.

### Killifishes of the Congo Basin

Because the genus *Aphyosemion* as usually understood is an assemblage of various species groups, in this article we will classify only the species of the *Aphyosemion elegans* species group as

*Aphyosemion* or *Aphyosemion* s. s. (*sensu strictu*, in the strict or narrow sense).

This group includes the type species of the genus, *Aphyosemion castaneum*. Other species groups already have an established name (usually described as a subgenus). In the event that there is still no (sub-) genus name described, the genus name will be given in quotes. This usage may be known to cichlid enthusiasts from the

former catch-all genus “*Cichlasoma*.” When we mean the entire erstwhile genus *Aphyosemion*, we will use the term *Aphyosemion s. l.* (*sensu lato*, in the broad sense).

At present, 22 *Aphyosemion s. l.*, 2 *Fenerbahce*, 7 *Epiplatys*, 5 *Nothobranchius* (family Nothobranchiidae), and 21 lampeyes (family Poeciliidae) are described from the Congo Basin. Even so, the killifish fauna of this region is only fragmentarily known, but that is changing quickly. Several institutions, including the Royal Museum for Central Africa (RMCA) in Belgium, the Zoologische Staatssammlung München (ZSM) in Munich, and the American Museum of Natural History (AMNH) in New York, have collaborated on expeditions with local biologists and students. In particular, the central Congo Basin, the lower Congo, and the northeastern DRC have been explored by various ichthyologists in recent years.

All these expeditions have discovered a number of noteworthy and hitherto undescribed fishes, including several killifish species. For example, a southern tributary of the Kasai was recently investigated by Jose Justin Mbimbi Mayi Munene, a student at the University of Kinshasa and a member of the AMNH Congo project for fieldwork and research on the fishes of the DRC. He collected not only an unusual black *Epiplatys*, but also two as-yet-undescribed *Hypsopanchax* species in a relatively small area in the middle section of the Lulua River.

The recently described “*Aphyosemion*” *teugelsi* was found in museum material collected back in 1939 from a southwestern tributary of the Kasai near the border with Angola. This indicates the likelihood that in the future we can expect to see more new species from the southern tributaries of the Congo Basin.

### *Aphyosemion sensu lato*

Compared with the region known as Lower Guinea (Equatorial Guinea, Gabon, Cameroon, and the coastal regions of the Congo Republic, the DRC, and Cabinda), *Aphyosemion s. l.* are poorly represented in the Congo Basin. Apart from 18 members of the *A. elegans* group (or *Aphyosemion sensu stricto*), only four additional species occur there: “*Aphyosemion*” *escherichi*, “*A.*” *labarrei*, “*A.*” *teugelsi*, and *Raddaella splendidum*.

“*Aphyosemion*” *escherichi* (Ahl 1924) is, like *Raddaella splendidum*, a member of the fish fauna of Lower Guinea that has managed to penetrate into the Congo drainage. *Raddaella*

*splendidum* achieved this in the northern Congo Basin, and the species has spread out from there for more than 600 miles (1,000 km). By contrast, “*Aphyosemion*” *escherichi* has penetrated only a few kilometers into the extreme west of the Congo drainage. The species was described from specimens caught at the foot of the Crystal Mountains in Gabon. “*Aphyosemion*” *microphthalmum* Lambert & Géry, 1968 (type locality: PK 85 on the Route Pointe Noire to Sunda, Congo Republic) and “*Aphyosemion*” *simulans* Radda & Huber, 1976 (type locality: stream on the road from Libreville to Cap Esterias, Gabon) are currently regarded as synonyms. “*Aphyosemion*” *escherichi* is distributed along the coast from northern Gabon to the lower course of the Congo.

“*Aphyosemion*” *labarrei* (Poll 1951) was described from the Inkisi, a southern tributary of the lower Congo. A few years ago Soleil Wamuini, a doctoral candidate at the University of Liege in Belgium, who was supervised by staff at the RMCA, prepared an inventory of the fish fauna of the Inkisi (Wamuini et al. 2010), and in the process discovered several previously unknown species related to “*A.*” *labarrei*. Their description is now in progress. Apart from two differently colored *Aphyosemion*



“*Aphyosemion*” *escherichi* from Mayombe, collected by A. Van Deun (May 2011) in Bas Congo.



*Aphyosemion castaneum* (HZ 85/8), north of Kisangani.

cf. *cognatum* populations, no further killifishes have been collected.

In May 2011, Armand Van Deun, a Belgian physician who regularly works in the Congo, brought back two new "*Aphyosemion*" *labarrei* populations that are now being bred by aquarist friends and distributed more widely. They come from two sites to the north and east of the type locality. The holotype in the RMCA differs considerably from the "*Aphyosemion*" *labarrei* aquarium strains known to date. It is a broader, compressed species with relatively long teeth and almost completely dark gray to black fins. Although the color pattern of "*Aphyosemion*"

*labarrei* resembles that of "*Aphyosemion*" *zygaima*, which lives on the other side of the Congo, DNA studies show that the closest relatives are found in a group consisting of *Aphyosemion*, *Raddaella*, and *Mesoaphyosemion* (the "*Aphyosemion*" *cameronense* species group), as well as the "*Aphyosemion*" *coeleste* and the "*Aphyosemion*" *wildekampi* species groups (Collier 2007, Murphy & Collier 1999).

"*Aphyosemion*" *teugelsi* (Van der Zee & Sonnenberg) was discovered in 2010 in the RMCA collection. This species is found in a very remote area in the south of the DRC, close to the border with Angola, at an altitude of 3,280 feet (1,000 m). Only *Kathetys elberti* and

*K. bamilekorum* have been found at greater altitude. Although "*Aphyosemion*" *teugelsi* exhibits a superficially similar color pattern to *A. congium*, the morphology is very different. This species is distinguished from those of the *A. elegans* group by the dorsal fin, which begins further forward and is relatively broad at the base, a larger head with relatively large eyes, and a more strongly upcurved dorsal profile. We were unable to assign it to any of the known species groups because of the morphological differences. Perhaps this fish belongs to a species group that lives in the hitherto rather inaccessible mountains of the southern Congo and northern Angola.

*Raddaella splendidum* (Pellegrin 1930). The *Raddaella* species are the only annual *Aphyosemion* s. l. They were long assigned to the genus *Fundulopanchax*, but DNA study shows that they definitely belong to *Aphyosemion* s. l. It is, however, unclear whether *Raddaella* is a monotypic genus with only one species, *R. batesii*, or whether *R. kunzi* and *R. splendidum* are also valid species. *Raddaella* species are the only *Aphyosemion* s. l. that occur in both Lower Guinea and the Congo Basin. The two species previously mentioned, which also occur in the Congo drainage, are restricted to western tributaries of the lower Congo. *Raddaella* are widespread in southern Cameroon and northern Gabon. To date, very few localities are known for them in Equatorial Guinea, the Congo Republic, and the DRC. Perhaps they reached the Congo Basin via the Likouala in the northwest.

The Likouala has tributaries that drain the southeastern part of Camer-



*Aphyosemion chauchei* (Obeya, RPC 91/6).



*Aphyosemion christyi* (HZ 85/14), photographed in 1988.



*Aphyosemion cognatum* from Kwambila.

oon. It is not unlikely that the change in the direction of flow of the Dja, which originally drained to the Atlantic coast, was originally responsible for the spread of *Raddaella* into the Congo Basin via the Ngoko, a tributary of the Likouala. *Raddaella* then spread upstream in an easterly direction. That wouldn't have been difficult—in this region the Congo has a drop of only 328 feet (100 m) over a distance of 1,242 miles (2,000 km), so it is more like a lake than a river.

### ***Aphyosemion sensu stricto***

This group contains the majority of the *Aphyosemion s. l.* species of the Congo Basin. They are broadly identical in morphology but differ considerably in the coloration of males and in their DNA. Eighteen species are currently recognized. The distribution of most species is very complex and exhibits a mosaic-like, parapatric pattern. They sometimes also occur sympatrically, that is, in the same river system. However, in only a few cases to date are two species known to be syntopic (found at the same site).

***Aphyosemion castaneum*** (Myers 1924) was described by the author from preserved material collected by an American expedition to the Congo. He established that the genus used in those days for more slender killifishes of Africa, *Haplochilus* (*Aplocheilus*, now restricted to Indian and Asian species), didn't constitute a homogenous group, and straightaway described the genus *Aphyosemion*. His newly described species *A. castaneum* was designated the type species of the genus. Authors such as Scheel, Radda, and Wildekamp regard *A. castaneum* as a synonym of *A. christyi*, but it has recently been shown that the occurrence of *A. christyi* is restricted to the eastern part of the Congo Basin at altitudes of 1,640 feet (500 m) and up, and that *A. castaneum* represents a valid species (Van der Zee & Huber 2006).

***Aphyosemion chauchel*** (Huber & Scheel 1981) is a "blue" species with blue dorsal and caudal fins and a yellow anal fin, found in a very limited area in the Congo Republic. In the west and south it is replaced by a "yellow" species with yellow fins, shown on the map as *A. "schioetzi"*. The body forms of *A. "schioetzi"* and *A. chauchel* are identical. They are relatively small and slender *Aphyosemion* species, unlike *A. schioetzi*, which is a comparatively robust species. *Aphyosemion schioetzi* and *A. "schioetzi"* are separated by a large distributional gap, and we believe that they do not represent a single species. Whether *A. "schioetzi"* is an as-yet-undescribed species



"*Aphyosemion*" *escherichi* from Mayombe, collected by A. Van Deun (May 2011) in Bas Congo.

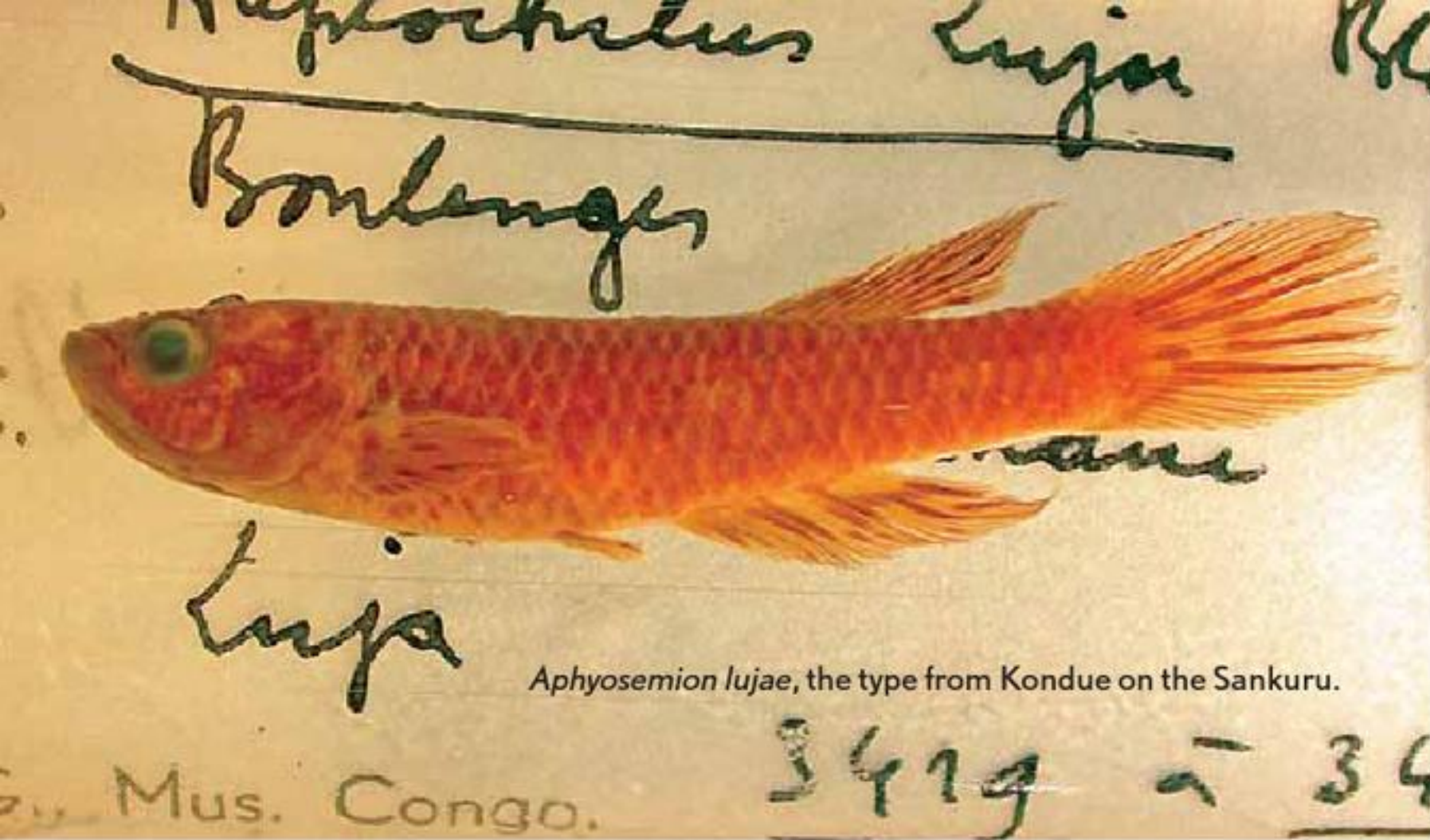


*Aphyosemion castaneum* (HZ 85/8), north of Kisangani.

remains unclear at present (see also *A. decorsei*). With one exception, all known locations for *A. chauchel* lie in the southern Likouala basin. A population from Olombo, which differs in color pattern from the Likouala populations, lives in the Alima drainage.

***Aphyosemion christyi*** (Boulenger 1915) is restricted to the Ituri forest region northeast of Bafwassende. *Aphyosemion margaretae* (Fowler 1936) is regarded as a synonym (Van der Zee & Huber 2006). Wild-caught specimens of this species have a very typical violet coloration. Even in poor-quality photos the species can be easily identified on this basis. *Aphyosemion christyi* is very widespread in the Okapi Faunal Reserve. Several collections have been made there recently by Emmanuel Vreven (RMCA) and his colleagues. So far, this is the only species of the *A. elegans* group that can be identified by its meristics (countable traits), as on average it has more rays in the dorsal fin than the other species.

***Aphyosemion cognatum*** (Meinken 1951) has a very large distribution in the southern Congo. The distance from west to east is almost 559 miles (900 km). At the same time, the species exhibits numerous different phenotypes. The DNA of an aquarium strain of one of the eastern populations (Lake Fwa) was studied by Murphy & Collier (1999). It turned out that there were no differences between the Lake Fwa and the Kinsuka populations (Van der Zee & Sonnenberg 2011). Hence it is possible that



*Aphyosemion lujae*, the type from Kondue on the Sankuru.



*Aphyosemion lamberti* (BSWG 97/9).



*Aphyosemion musafirii* (AVD 1), 4.3 miles (7 km) north of Ubundu, wild-caught male, 2007.

since their importation the two strains have been mixed in the killifish hobby or incorrectly identified. More study is needed to demonstrate whether this is actually a single species with a large distribution or several species with a parapatric distribution, inhabiting adjoining ranges.

***Aphyosemion conglcum*** (Ahl 1924). Genetic research (surprisingly) places this species in a group with *A. castaneum* and *A. musafirii* (Van der Zee & Sonnenberg 2011). The species is known from only two sites in the southern

the fin. In the original description of *A. decorsei* Pellegrin wrote that the dorsal, anal, and ventral fins are covered with small, more or less numerous carmine red dots. We concur with Wildekamp's argument: *A. decorsei* is a species with numerous dots, at least on the anal fin. But that doesn't solve the problem of whether *A. decorsei* is a "yellow" fish like *A. "schioetzi"* and *A. sp. RCA 3*, collected by Pratt in 1983, or a "blue" fish like *A. sp. "Lobaye."* Only further collections and photos of live fishes from the area

Congo; both were discovered by Radda in 1982. The species description is based on specimens with the locality given as "Congo." At present, *A. melanopteron* Goldstein & Ricco 1970, whose type locality is also unknown, is regarded as a synonym. By contrast, Huber is of the opinion that the description by Ahl shows that *A. conglcum* differs from *A. melanopteron*, as the former supposedly has many more red dots on the side (2007, online version [www.killi-data.org](http://www.killi-data.org)). Unfortunately, the preserved type specimens in general no longer exhibit any traces of coloration.

***Aphyosemion decorsei*** (Pellegrin 1904) is one of the most confused species of the *A. elegans* group. The status of *A. decorsei* has long been debated. Poll placed it in the genus *Epiplatys*, and in the description of *Haplochilus decorsei* Pellegrin even assumed a close relationship with *Aplocheilichthys spilauchen*. Myers (1924) tentatively placed the species in *Aphyosemion*. Scheel, Huber, and Wildekamp have examined all the types and confirmed Myers's view. The type specimens originate from the south of the Central African Republic and are in poor condition, without any remaining traces of coloration. Huber suggests that *A. decorsei* has very few red dots on the side and is conspecific with *A. polli*; the latter would then be a synonym. Wildekamp (1993), by contrast, is convinced that *A. decorsei* has numerous dots on the side, based on the light spots on the scales of the syntypes. After preservation in formalin and subsequent transfer into alcohol, red pigments leave behind corresponding areas that are lighter than the body base coloration. *Aphyosemion polli* has not only few spots on the side, but also very few (or none at all) on the anal fin. These are arranged at the base of

of the type locality will permit unequivocal clarification.

*Aphyosemion elegans* (Boulenger 1899) is not identical with the species known to aquarists for decades under this name. In the 1950s the Belgian aquarist Lambert introduced killifishes from Boende labeled *A. elegans* into the aquarium hobby. We (Van der Zee & Sonnenberg 2011) argue instead that Lambert's fishes (which we term *A. sp.* "Cuvette") do not agree with Boulenger's description of *A. elegans*. This incorrectly identified species has a very characteristic dark red dorsal fin, which is also clearly recognizable in preserved specimens. Boulenger doesn't mention this character in the text of the description of *A. elegans*, and no dark dorsal fin is shown in the illustration accompanying the description. Uli Schliewen brought what is probably the real *A. elegans* to Germany from Mbombokonda. *Aphyosemion sp.* "Bombala" also represents *A. elegans*, as does a commercial importation in 2006 from the Tshuapa in the Boende region. *Aphyosemion elegans* and the species recently described by us as *A. pseudoelegans* occur sympatrically in the central Congo Basin.

*Aphyosemion ferranti* (Boulenger 1910) is currently known only from preserved specimens from various locations in the southeast of the Congo. The species can (purportedly) be identified very easily by the red longitudinal band on the side of the body. But there is at least one further, undescribed species from the northern Congo with a similar band. Perhaps a better character is the unusual, asymmetric color pattern on the caudal fin: spotted above, without spots below. The species also differs in further characters from the other *Aphyosemion* species and may belong in another species group, maybe with "*Aphyosemion teugelsi*". New collections of both species, above all of live specimens and DNA samples, may solve many unanswered questions.

*Aphyosemion lamberti* (Radda & Huber 1977) is widely distributed in Gabon. *Aphyosemion lamberti* and *A. rectogoense* are sibling species and, so far, the only members of the genus *Aphyosemion* that occur outside the Congo Basin. To date it remains unknown whether the genus *Aphyosemion* colonized the Congo drainage from southeast Gabon or the ancestors of these two species came from the Congo Basin. DNA results so far seem to point to the second possibility. Like all other members of the species group, *A. lamberti* is also a rainforest dweller, while *A. rectogoense* is the only savanna dweller.

*Aphyosemion lefinlense* (Woeltjes 1984) is restricted to the Lefini on the west bank of the Congo in the Congo Republic. After the first collection, on which the description was based, it wasn't until 2005 that staff from the RMCA were able to find this species again at various sites in the Lefini. This species is very rare in the aquarium hobby, and the captive population may even have died out completely a few years ago.

*Aphyosemion lujae* (Boulenger 1911) is currently known only from preserved specimens that originated from the Sankuru system, a tributary of the Kasai, at Kondue. *Aphyosemion ferranti* is also found near Kondue. This species was, however, also collected at various places around Bena Tshadi in 1974 and 1979. It remains unclear whether the currently known locations for *A. ferranti* and *A. lujae* in the vicinity of Kondue represent the southern boundary of the distribution of *Aphyosemion*, or whether the southern tributaries of the Kasai harbor additional, as-yet-unknown species.

*Aphyosemion musafirli* (Van der Zee & Sonnenberg 2011) was only recently described. The species was caught by Armand van Deun (AVD) in 2007, and specimens from two populations were brought back alive to Europe. These fishes have been maintained and bred in the hobby as *A. sp.* AVD 1 and AVD 2. Although the



*Aphyosemion plagitaenium* from Epoma (RPC 91/1).



*Aphyosemion pseudoelegans* from Boende, imported in 2002.



*Aphyosemion pseudoelegans* from Boende, imported in 2002.



*Aphyosemion rectogoense* from site PEG 95/16.



*Aphyosemion schioetzi* from Kintete.

species looks more like a member of the *A. cognatum* group (numerous red dots on the sides of the body in males), its closest relative is *A. castaneum*, which lives on the other side of the Congo. DNA indicates that the two species may have been separated as long ago as one to two million years.

*Aphyosemion plagitaenulum* (Huber 2004) was dis-

covered in 1991 during a collecting trip by Dutch and Belgian aquarists to the Congo Republic. It was known as *A. sp.* "Epoma RPC 91/1" prior to its description. This species, which has a remarkable color pattern, is so far known from only a single location in the system of the Mambili River, a tributary of the Likouala.

*Aphyosemion polli* (Radda & Pürzl 1987) was described from N'djili (Z 82/26), close to the international airport near Kinshasa in the DRC. Many authors regard *A. polli* as a synonym of *A. schoutedeni* or *A. decorsei*, but we are convinced that *A. polli* is a valid species (see *A. schoutedeni* and *A. decorsei*). This species (if *A. cf. polli* is included, see map) is widespread in the Congo Basin. Collections known to date took place along the Uele, Ubanghi, and Congo. Apart from a number of populations in the north of the Congo Republic, which were collected by Huber, and a population from a southern tributary of the Kasai, all collections have been made relatively close to the main rivers. Unfortunately, no photos of Huber's collections were published, so the identification of the species cannot be checked. The preserved specimens from the southern location in the Kasai drainage exhibit the same color pattern as *A. polli*, but the dots on the sides aren't round; they look like little crosses. Until new collections permit a definite identification, the unclear status of this fish should be expressed by the designation *A. cf. polli*.

*Aphyosemion pseudoelegans* (Sonnenberg & Van der Zee 2012) is a species already known in the aquarium hobby, but has hitherto been incorrectly labeled as *A. elegans* (see *A. elegans*). It is known from several locations south of the Congo in the central Congo Basin and is found there sympatric and, in some cases, also syntopic with *A. elegans*, *A. cf. castaneum*,

and a further, not-yet-described *Aphyosemion* species. Its characteristic characters are the dark red coloration of the dorsal fin (versus red dots on a light background in *A. elegans*) and an asymmetric sequence in the color pattern of the fin edges of the caudal fin.

*Aphyosemion rectogoense* (Radda & Huber 1977) is the sister species of *A. lamberti* on the basis of DNA

study. Ten localities are known in the hobby and all populations are very similar. There are, to date, only three collections in museums. This is the only *Aphyosemion s. l.* species on the IUCN Red List. This because of its small distribution region in the upper Lékoni-Djouya and the upper Mpassa in the Ogooue basin in southeast Gabon. The occurrence of this species has been heavily affected by pollution of the waters in the vicinity of Franceville and deforestation leading to increased sedimentation.

***Aphyosemion schloetzi*** (Huber & Scheel 1981) is the only representative of the *A. elegans* group in the lower Congo to the north of the river. Its distribution is limited to an area measuring around 62 x 62 miles (100 x 100 km), with the majority of known populations in the DRC and two (including the type locality) in the Congo Republic. We do not concur with many other authors that this species also occurs in the northern Congo with a distributional gap of more than 259 miles (400 km) (see *A. chauchei*), but suggest that a further, probably still undescribed *Aphyosemion* species is involved, shown on the map as *A. "schloetzi."* *Aphyosemion schloetzi* populations exhibit a relatively uniform color pattern, unlike the related species *A. cognatum*, in which numerous different phenotypes are known.

***Aphyosemion schoutedeni*** (Boulenger 1920) has hitherto been assumed to be restricted to the type locality Medje, around 186 miles (300 km) northeast of Kisangani in the northeast of the DRC. Although the types are in good condition, all traces of coloration have disappeared. But to the present day, topotypes collected by Lang and Chapin in 1910 have retained their color pattern (Van der Zee & Huber 2006), which resembles that of *A. castaneum* except for the pattern of the anal fin. This color pattern is found in various RMCA *Aphyosemion* collections that originate from the Aruwimi basin east of the Kisangani-Buta road. Hence it can be assumed that the distribution region is significantly larger than previously thought.

## Taxonomy in upheaval: the genus *Aphyosemion*

DNA studies indicate that the genus *Aphyosemion* is a complex assemblage of genetically clearly distinguishable species groups and isolated species. So far only the most obviously distinct species groups have been described as genera or subgenera (eg *Chromaphyosemion*, *Kathetys*, *Diapteron*, *Episemion*, *Raddaella*). On the other hand, right from the start the subgenus *Mesoaphyosemion* was the "rubbish bin" for all the difficult-to-classify species and species groups.

And therein also lies a problem with the taxonomy of *Aphyosemion s. l.* Humans, as sight-oriented animals, can very easily appreciate the definition of *Chromaphyosemion* or *Diapteron*, as the species within these groups are very similar, but exhibit clear differences from other *Aphyosemion*. This is less apparent with other groups, for example the "A." *wildekampii* and "A." *cameronense* species groups. Molecular genetic studies indicate, however, that phylogenetically speaking, the visually very distinct species groups are not necessarily more genetically distant from one another.

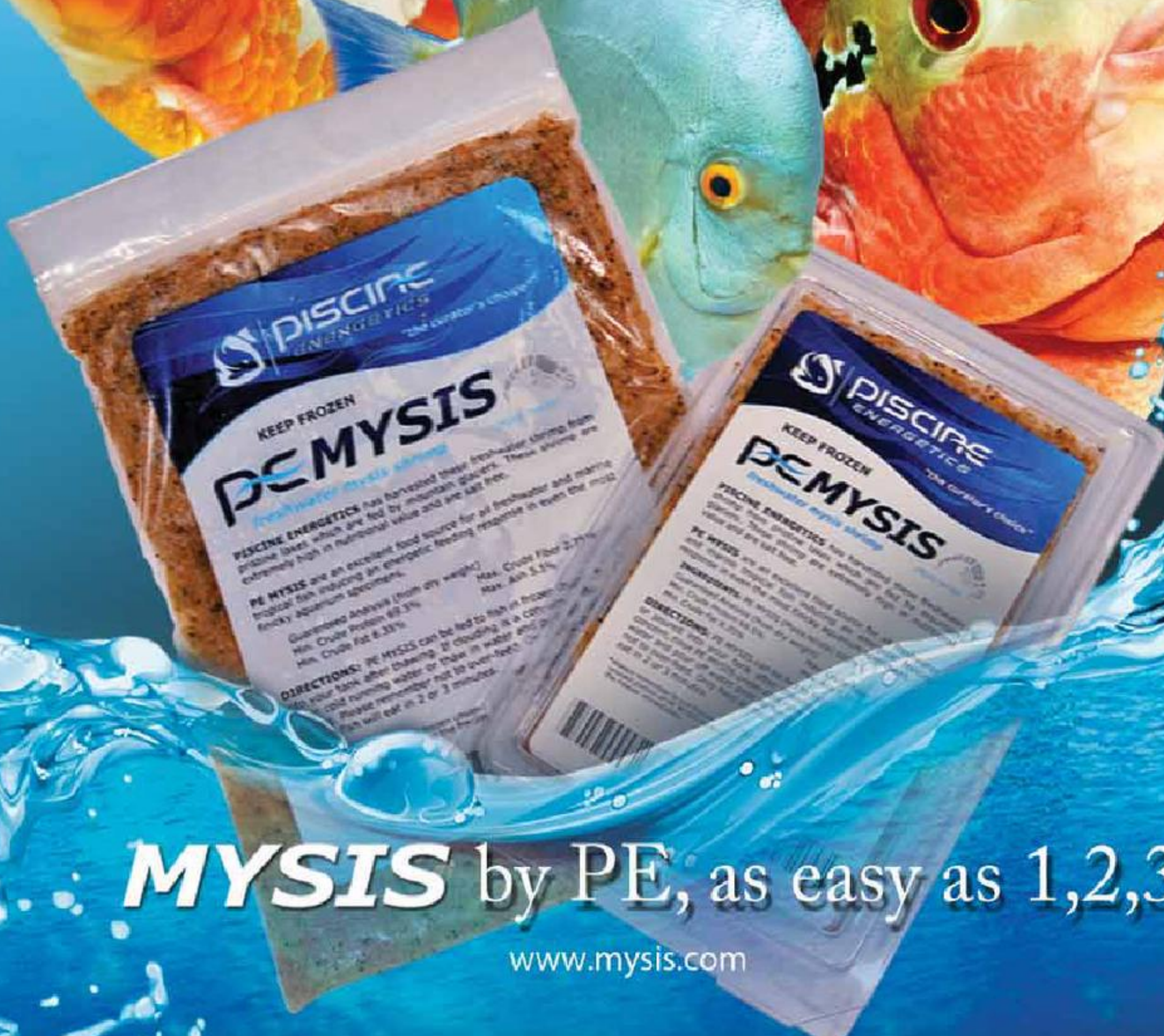
Now there are two taxonomic possibilities here: either accept that the other species groups also represent separate genera, just like *Diapteron*, *Episemion*, and others. Or put them all in a genus *Aphyosemion s. l.* with numerous subgenera. But that doesn't solve the problem of the species groups so far without any name, whether as subgenus or genus.

From a pragmatic viewpoint a catch-all genus *Aphyosemion* provides less information content than *Diapteron* or *Chromaphyosemion*, for example. For practical purposes it is all the same whether we use species-group names (e.g., the *Aphyosemion bivittatum* or *A. georgia* group) or scientific names (*Chromaphyosemion*, *Diapteron*) for the different groups. A species group equates to what some authors call either a subgenus or genus. Hence, as far as the aquarium hobby is concerned we can regard the terms "species group," "subgenus," and "genus" as essentially equivalent.

Just as with the species groups, it is often the case at species level as well that usually the most distinctive species are described first. A good example is the *A. cameronense* species group or *Mesoaphyosemion*: populations are termed *M. cameronense* that do not have a particularly distinctive body coloration, that is, have metallic blue to blue-green on the sides of the body, overlain with a very variable red pattern. Several obviously different phenotypes have been described in recent decades, for example *M. amoenum* and *M. halleri*, which both have a yellow caudal peduncle, and *M. maculatum* and *M. mimbon*, which possess a spotted pattern on the sides. Genetic studies indicate that many of the blue forms of *M. cameronense* are just as different genetically as the phenotypically more distinct, described species. Here, too, there are two solutions: lump everything together in the species *M. cameronense*, which would be to ignore major genetic and phenotypical differences between the phenotypes, or retain the existing species and acknowledge that *M. cameronense* as currently understood represents a species complex. It is for precisely such situations that the use of the aforementioned locality codes is important, because that way name changes can be understood, regardless of where these fishes belong taxonomically and where they come from.



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## Undescribed species

The western part of the Congo Basin has already been well explored, and it is likely that few new species will be discovered in this region. But nothing can be ruled out: Huber didn't find *Aphyosemion plagitaenium* when he collected in this area back in 1978; it was discovered by De Waegeneer, Vlym, and Van der Berg in 1991 during the RPC trip. This species appears to be restricted to a very small area, and there may be other species with very limited distribution regions of this type. On the other hand, *A. "schioetzi"* was collected several times by Huber at different locations, but not by the RPC team in 1991.

The northern part of the Congo drainage undoubtedly harbors as yet undescribed species, because, for example, several very different-looking (even when preserved) *Aphyosemion*, which do not accord with any currently known species, were collected there by missionaries and deposited in museums. There are at least two phenotypes that may represent new species in the rainforest between the Uele and the Congo. One of them was recently collected and photographed by Uli Schliewen (ZSM).

A very interesting species lives in the savanna in the northeast of the Uele basin. To date the only savanna-dwellers recognized within *Aphyosemion s. l.* are *Kathetys elberti*, *K. bamilekorum*, and *Aphyosemion rectogoense*. Unfortunately, no traces of the color pattern remain visible in the preserved specimens. A possibly new *Epiplatys* species has also been found in the same area.

In various places in the east, south of the distribution of *Aphyosemion christyi*, a phenotype occurs that has a rather similar color pattern to *A. christyi*; the red dots are, however, much smaller. It is probable that further differences will be found as soon as the live coloration of this species is known.

So far there have been only a very few collections made in the southern part of the Congo Basin. Every southern tributary of the Kasai possibly has its own endemic species, as all these rivers are separated from one another by savanna. As already mentioned above, at least one striking fish, similar to *Aphyosemion polli*, occurs there. The distance from other *A. polli* localities is very great. That would give *Aphyosemion polli* probably the largest distribution of all *Aphyosemion s. l.* with the exception of *Raddaella batesii*. On the other hand, the similarity of the color pattern (in preserved specimens) may be coincidental.

A collecting trip east from Kinshasa, investigating every southern tributary of the Kasai, would probably produce very exciting results. Initially you would find *Aphyosemion cognatum* and *A. congicum*. Further south in the Wamba, you would probably be able to capture "*Aphyosemion*" *teugelsi*. But thereafter, further east, every catch would likely be a surprise. Another interesting trip would be a journey along the northern border of Angola. Although the numerous Kasai tributaries offer promising habitats, to date not a single *Aphyosemion* has been collected there. So far, only a number of interesting lampeyes are known from this region, unfortunately only as preserved material. 🐟

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Extensive references for this article can be found online at the Reef to Rainforest site: <http://www.reef2rainforest.com/aphyosemion-issue-references/>.

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# The keeping of *Aphyosemion* in the aquarium



by *Olaf Deters* • It is hard to imagine how a fish can be attractive, colorful, not too large, peaceful, and interesting, and still not be common in the aquarium hobby, but this has been true of killifishes for years. In hopes of awakening more interest in them, I will spell out just what the aquarist needs to know to keep *Aphyosemion* species successfully.

Opposite page, top: The “Cape Lopez,” here the golden form of *Aphyosemion australe*, is the best-known member of the genus.

Middle: *Aphyosemion castaneum* is very attractive, but unfortunately also very demanding.

Bottom: *Aphyosemion striatum* is also found in the trade now and then. The species tolerates higher temperatures.

The killifishes have been known to generations of aquarium keepers, and there are numerous species; they deserve greater recognition on account of their colors, but only a few standard species are found in the aquarium trade—for example, *Aphyosemion australe*, known as the “Cape Lopez” killie. Interestingly, *Aphyosemion australe* is not considered the easiest species in the genus to maintain.

One reason for the poor spread of *Aphyosemion* species in the aquarium hobby may be certain long-standing prejudices against them, which cannot be entirely discounted. Nevertheless, the species are not really complicated—many “standard fishes” are more demanding. The aquarist needs only to make a few adjustments in order to keep *Aphyosemion*, and they will generally prove to be rewarding pets.

## Accomplished jumpers

There is the matter of jumping, for example. Yes, *Aphyosemion* can and will jump out of the aquarium if given the opportunity. In the wild they are not at the top of the food chain, so they try to evade their predators by escaping into areas where the water is shallow, sometimes only a few centimeters deep. Should danger also threaten there, the best escape method is to leap up, quickly and as far as possible.

However, this behavior isn’t equally expressed in all species. Some exhibit jumping behavior in an extreme form, others not at all. But for safety’s sake, the aquarium for *Aphyosemion* should be tightly covered. These

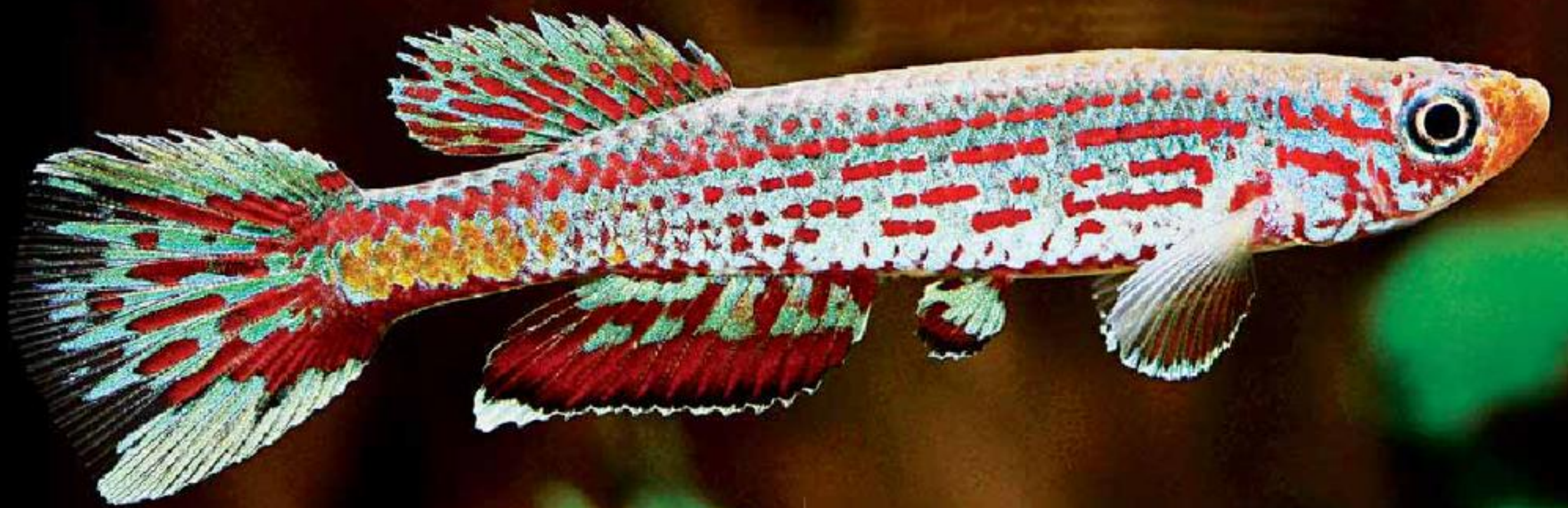
fishes will find the smallest gap in the cover glass, for example where filter parts enter or exit. Any gaps can be plugged with filter wool. If you don’t take these precautions, things may be fine for a while, but one day you will find a desiccated mummy on the floor or a fish will have disappeared without trace.

It is also believed that killifishes aren’t long-lived. They certainly don’t live to be ancient, but it is usually possible to keep them for two or three years, and sometimes longer, though you shouldn’t raise your expectations too high. *Aphyosemion* will seek to breed if given the opportunity, but the presence of a mate causes continual stress, which inevitably shortens the lives of the fishes. It is questionable whether the alternative of keeping them singly to prolong life expectancy is really wise. Moreover, in the long term, over-warm water can reduce life expectancy.

## Water and temperature

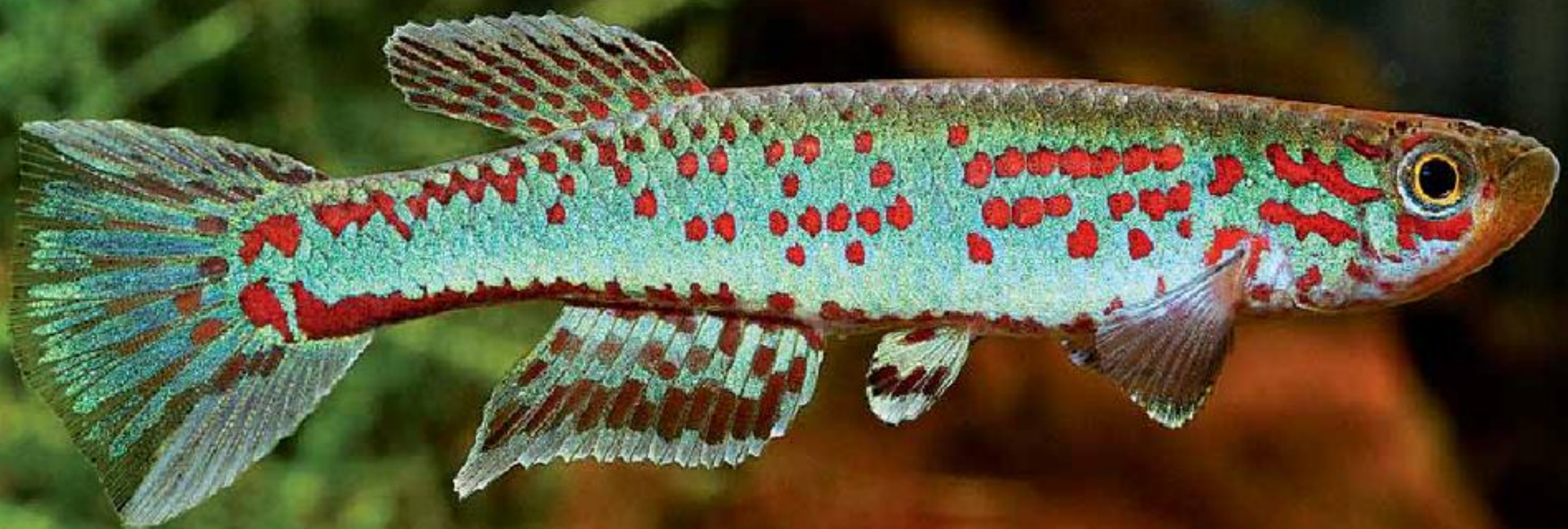
It is sometimes stated that *Aphyosemion* are demanding when it comes to the water, and that idea didn’t appear out of thin air. These fishes come mainly from flowing waters and won’t tolerate old and polluted water for long. They may survive for a while in such conditions, but they will age more rapidly. So regular water changes are very beneficial for them. On the other hand, special preparation of the water is only necessary if it is very hard. The majority of *Aphyosemion* species can readily be maintained and even bred in medium-hard tap water.

The correct water temperature is of some



*Aphyosemion cameronense* is widely distributed and very variable in appearance.

*Aphyosemion cameronense* (locality BSW9920).



Left: Female *Aphyosemion* are rather plainly colored. Only in *Aphyosemion hera* (right) are the females very colorful.



importance. Inland species, in particular those from higher regions, prefer temperatures of around 68–70°F (20–21°C), sometimes even lower. The average domestic aquarium cannot provide this, so you should think carefully before acquiring such species. However, these cool-water species are rarely found in the aquarium trade. Examples of species that require cooler maintenance include *Aphyosemion mimbou*, *A. coeleste*, and *A. maculatum*.

On the other hand, coastal species or species from the lowlands and savanna regions live at temperatures similar to those in our aquariums. The water parameters there generally resemble those of average tap water, so such species are better suited to the normal aquarium than species from the interior. Suitable species include *Aphyosemion australe*, *A. striatum*, *A. primigenium*, and *A. marginatum*, for example.

### Everything but greens

Diet has a significant influence on these fishes. Essentially, green food is of no interest to *Aphyosemion*. They will take any live foods that they can overpower, from all sorts of mosquito and midge larvae, water fleas, *Cyclops*, and fruit flies to *Tubifex* and White or Grindal Worms. *Aphyosemion* will also reliably take *Artemia* nauplii as long as the latter remain alive, but they aren't adequate food for larger fishes in the long term. With good feeding the females will visibly fill with eggs. If this doesn't happen for an extended period, other foods should be offered.

In my personal experience, *Aphyosemion* much prefer live food, and fishes that are accustomed to it are reluctant to take frozen or dry food. This can cause problems in times of live-food shortage. Naturally that doesn't happen with frozen or dry food, as these are always available.

### Not territorial

*Aphyosemion* are not considered aggressive towards other fishes. However, within the genus and, naturally, within their own species, there are sometimes very violent squabbles. Noticeably weaker individuals can suffer badly as a result. And females will vigorously harass males that are very small. It is not usually possible to predict if this will happen. Note that in some individual species, for example *Aphyosemion amoenum*, it is not unusual for females to grow more rapidly and become significantly larger and stronger than males.

Some individuals are very timid. This isn't necessarily due to an error in maintenance; even in the wild it is undoubtedly advantageous to the survival of the species for there to be cautious as well as outgoing specimens. In times when food is in short supply, the outgoing individuals are at an advantage, but in the event of major predation pressure it is the retiring specimens that will survive.

*Aphyosemion* are not territorial in the normal sense,

and hence no obvious territories are established. Where several fishes live together in an aquarium there is a high probability that there will be a "top dog" who chases the other males and pursues the females. The almost constant harassment of females by males is part of normal behavior. Healthy individuals can cope with that, and there should be no losses as long as there are places to which subordinate males and oppressed females can retire. Only extremely weak specimens will be unable to cope in the long term.

### Danger of hybridization

Generally speaking, *Aphyosemion* species can be kept with other fish species; as a rule they do not occur alone in the wild. However, tankmates should never look similar to their predators, which include larger characins and cichlids. And they don't need to be actually dangerous for *Aphyosemion*. It is enough if their appearance causes the *Aphyosemion* anxiety. On the other hand, small tetras and small barbs are fine. In addition, fish species from other regions can generally be kept with *Aphyosemion*, as long as they don't actually hunt them.

If you really want to obtain the maximum benefit from these fishes in the aquarium, it is advisable to buy not just a trio, but a larger number, all at the same time. That can mean four pairs or more. The fishes will then exhibit more natural behavior and will be constantly visible and less retiring.

It is also possible to keep several *Aphyosemion* species together in the aquarium, but only if you have no ambition to breed them. Because many of the females look very similar and related species will generally cross, you should at least ensure that the species chosen are as different from one another as possible. But any fry that may turn up should never leave your home.

### Not too much light, not too much space

The subject of minimum aquarium size conceals numerous pitfalls, especially when it comes to the killifish hobby. Be that as it may, the usual 2-foot (60-cm) beginner's aquarium of 15–20 gallons is suitable for up to four pairs of adult *Aphyosemion*. And you can usually keep even more in it. Problems arise only when a single dominant individual terrorizes the other fishes. In such cases, even a larger aquarium doesn't guarantee a solution. The dominant individual chases the others all over the aquarium and the weak specimens can't keep out of sight of the alpha individual for long. In my experience *Aphyosemion* are often rather shy and retiring in larger aquariums. Only if there are sufficient fishes of a species present will they be lively and outgoing in large aquariums as well.

*Aphyosemion* have only a limited acquaintance with lush aquatic plants in their native waters—usually streams that, depending on the time of year and the amount of precipitation, are a few meters wide and a few



*Aphyosemion amoenum* females grow larger than the males.



*Aphyosemion mimbon* likes cooler conditions.



The larger-growing *Aphyosemion herzogi* lives in shallow water.

### The mystery of the locality code explained

Killifish names often have strange-looking abbreviations appended, for example BDBG 04/15 “Lolo1” or LEC 93/4. These codes make it possible to keep different populations separate and avoid mixing them together in the aquarium hobby. These codes are assigned at the discretion of the collectors and are not subject to any particular rules. They contain fundamental information and also permit the addition of further data. Thus BDBG stands for the two collectors Bogaerts and de Bruyn, and the G represents the country of Gabon; 04 indicates the year 2004 and the 15 stands for collecting site no. 15. “Lolo1” refers to the nearby settlement.

Anyone working with these fishes can find out, on the Internet, for example, who is behind the codes. Sometimes you can find very precise additional habitat data in the process, including the GPS data of the location, the time of capture, and other details such as water depth, current speed, air and water temperatures, water parameters, and other fishes caught there. Because the codes describe collecting sites, it may well happen that two different, but syntopic killifish species bear the same code if they were caught together at the same site.

How far the information goes is at the discretion of the collector. As can be seen from the other articles here, the taxonomy of *Aphyosemion* is still unresolved, and it is likely that we can expect name changes and new species descriptions. Names may be altered, but locality codes remain unchanged. In this way it is possible to tell what fish was originally involved, even after a revision.

Information on *Aphyosemion* and other killifishes can be found on the Internet at the American Killifish Association ([www.aka.org](http://www.aka.org)) or the UK Killifish site ([www.killi.co.uk](http://www.killi.co.uk)). For online purchase directly from breeders, most of them in the United States, [www.AquaBid.com](http://www.AquaBid.com) usually sells various killifish and killifish eggs, including *Aphyosemion* spp., at auction.

deep but may also be very narrow and shallow. Popular haunts are shallow areas with trailing bank vegetation or submerged grasses. Depending on the region, these areas may also be shaded by surrounding trees. Still, a planted aquarium is appreciated. But cover in the form of bogwood and oak leaves is equally well accepted. Caves may be investigated out of curiosity, but not deliberately used.

Bright lighting can cause the fishes to become more timid and their splendid coloration won't look as good. If the vegetation is feathery, there is even a possibility that the fishes will spawn in it and occasional juveniles will survive. If this happens regularly and you want to keep the young, you should remove the larger youngsters—they often pose a greater danger to their younger siblings than the parents do.

It should be obvious that an open-topped aquarium is out of the question because of the tendency of the fishes to jump. You can, of

course, allow the surface to become overgrown with floating plants in order to limit the jumping to some extent, but this offers no guarantee that jumping won't occur.

Smaller aquariums with a volume of 6–7 gallons (25 L) are also fine if used as species tanks.

### Suitable starter species

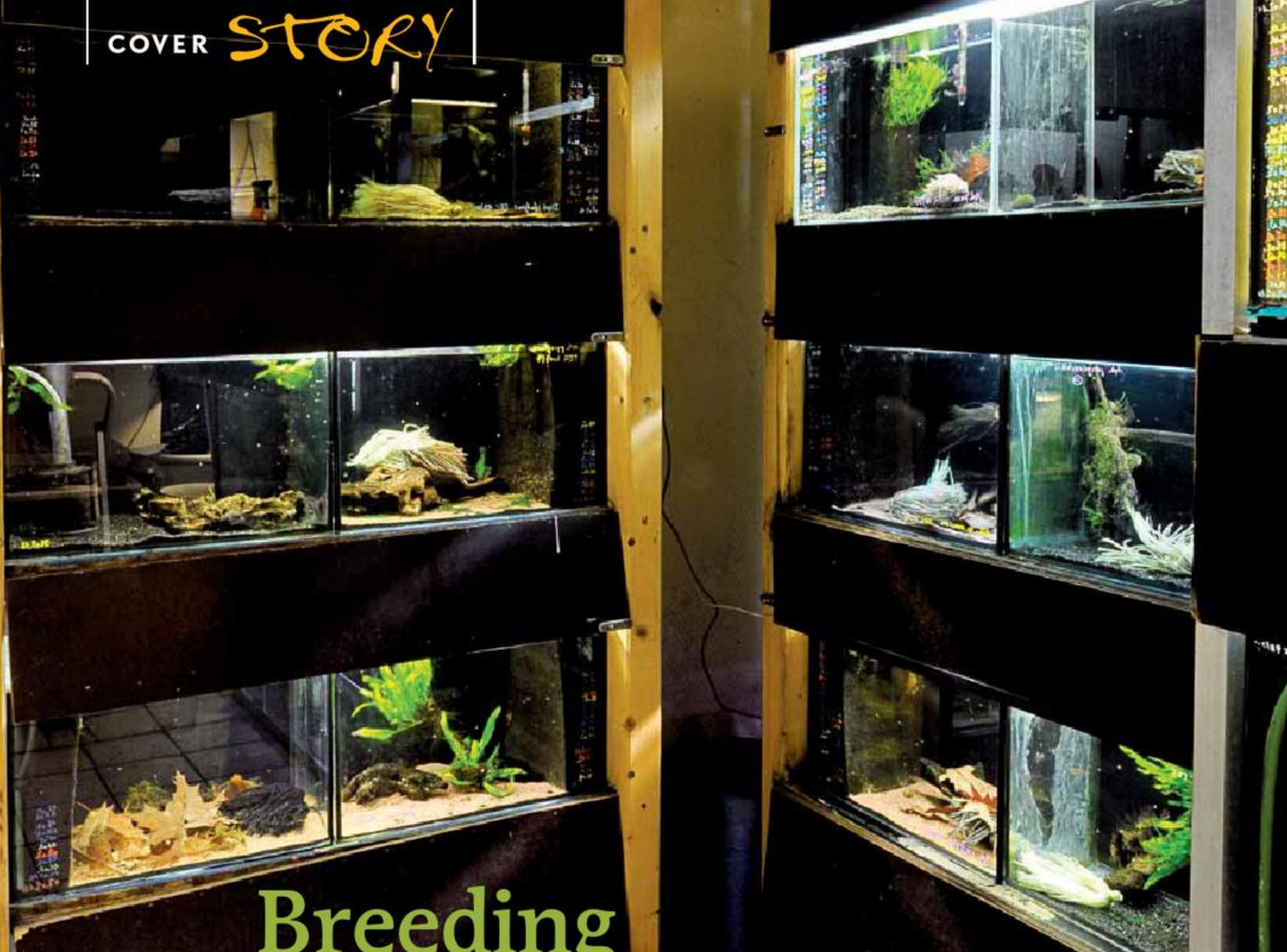
There are many species that could be listed here. I would suggest first and foremost the coastal species—that is, those that need to be kept warmer and will tolerate tap water. The problem is that with a few exceptions, they are not available in the trade. *Aphyosemion australe* and *Aphyosemion striatum* are well known and available. *Aphyosemion marginatum* and *Aphyosemion primigenium* are at least as attractive, but are not common in the trade.

In my opinion there is a further reason why *Aphyosemion* species are not often found in the trade: wild-caught specimens are rarely available. As a result, the killies don't come to the attention of the public and are regarded as demanding and exotic. The deliberate breeding of *Aphyosemion* is relatively time-consuming, and large numbers cannot be produced without expense and effort. So killifishes in general, and *Aphyosemion*

in particular, have for many years remained hobby fishes reserved for enthusiasts. 🐟



*Neolebias unifasciatus* is found together with *Aphyosemion*.



# Breeding *Aphyosemion*

by Olaf Deters and Michael Schlüter • First the bad news: Breeding *Aphyosemion* is the opposite of making lots of money for little effort. Anyone who wants to breed *Aphyosemion* must make quite a large commitment. The adults neither tend the eggs nor care for their offspring, so you don't always get many offspring. And the breeder must constantly be on the ball—intervening, looking for eggs, and sorting out dead ones every day. Rearing the fry is work, too. It is possible to mass-produce some species, but the outcome can't be predicted.

Above: Part of a breeding setup for *Aphyosemion* species.

Right: A courting pair of *Aphyosemion* sp. "Oyo," a member of the *A. elegans* group.



Killifish are associated with the ability to survive in bodies of water that dry up periodically. The development of the eggs extends over the dry period, and the next generation hatches with the next rainy season. The eggs can remain dormant for many months, and not all the fry hatch in the first rain; it might be not a downpour, but just a brief cloudburst.

This ability is exhibited by the so-called annual killifish. Typical annual genera include the East African *Nothobranchius* and the South American *Austrolebias* and *Simpsonichthys*, for example.

These genera unconditionally require a dry, dormant period for the eggs, as otherwise they won't develop.

But the majority of killifishes are not annual species. Their eggs develop over a predictable period of between 10 days and three or four weeks. So they don't absolutely need to be kept in a substrate such as peat or chopped coconut hair to simulate a dry period in contact with air, but can generally also develop in water. Such species are termed "non-annual."

There are also semi-annual killifishes, whose biotopes dry up only occasionally. The eggs of these species will develop both in water and in a substrate. The eggs don't stick to plants, so in this case, too, peat or something similar should be used as a spawning substrate.

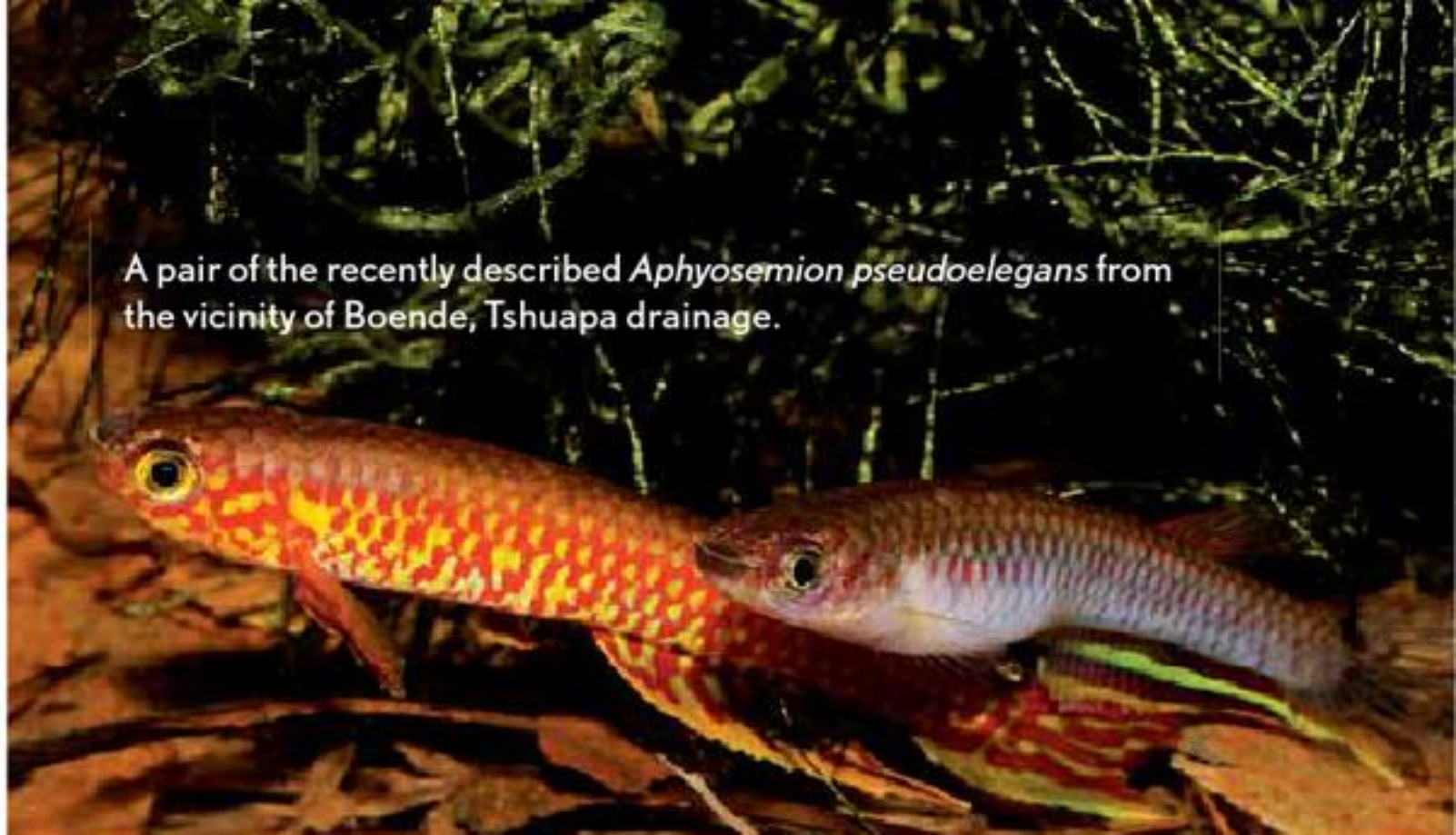
*Aphyosemion* are non-annual killies. The development of the eggs takes around two to three weeks, with temperature-induced variations up or down. If the upper boundary of the time window is greatly exceeded, the embryo will die while still in the egg or will be too weak to break through the eggshell completely.

### Continuous spawners

*Aphyosemion* are so-called continuous spawners. If the fishes are in good condition and in the right mood, they will lay a few eggs every day for a long period of time. The number of eggs can vary from 0 to 20. If the sexes are separated for several days beforehand, large females may produce as many as 100 or more eggs initially, but not infrequently the loss rate is very high if there are a lot of eggs. The dead eggs fungus rapidly and infect the good ones, and in the end you are left with none. For this reason it isn't especially desirable to get a large number of eggs from a pair all at once.

A prerequisite for spawning is that the fishes should be in good condition, and that is not least the result of heavy feeding. The females should be visibly full of eggs. They shouldn't be full to bursting, but nothing can be expected from noticeably slim individuals. It is usual to offer live foods such as mosquito larvae or *Cyclops*. Lots of fatty foods, such as *Tubifex* or White Worms, will encourage egg formation. Some species will accept frozen food, as long as they are accustomed to it.

It is always astonishing how rapidly the fishes react to changes and improvements in feeding. If they have



A pair of the recently described *Aphyosemion pseudoelegans* from the vicinity of Boende, Tshuapa drainage.



Male *Aphyosemion buytaerti* BSW 99-03.



*Aphyosemion herzogi* from Zomoko GBG 92-25.

been fed sparingly for some time and haven't spawned much, or at all, you will often find significantly more eggs a day or two after enriching the diet with a hefty portion of live food.

*Aphyosemion* do not exhibit multifaceted courtship behavior like many cichlids and gouramis. Instead, they get right to the point. The male drives the female around the aquarium and, when the opportunity arises, positions himself in front of her and excitedly displays the maximum possible splendor of coloration and finnage. In some species the mouth area becomes as yellow as a bright lemon as well—a pretty impressive sight.

If the female is willing to spawn, the pair press into the spawning substrate together and she lays an egg. If the female isn't yet convinced, she is chased around the tank time and again until she changes her mind. Should



Above: Pairs or groups of fishes can be placed in plastic containers. In this one, Perlon mesh and mops made of artificial wool (left) serve as spawning substrates.

the female become excessively stressed by the pushiness of the male, she will seek out a hiding place. For this reason it is advisable to make sure hiding places are available—otherwise the male can become too rough, and weaker females occasionally succumb. The burden on individual females can also be reduced by using two females and a male, a so-called trio. However, sometimes a pair forms and the second female is then chased by both fishes, or she eats the eggs laid by the spawning pair. It is thus wise to watch the fish carefully at first so as to be able to intervene if necessary.

That said, a certain amount of tension between the partners is generally desirable. Pairs that live together too peacefully and harmoniously in the aquarium often lay no eggs for long periods, if they lay any at all. The idyll is thus deceptive in a breeding context. In such cases,

temporary separation of the sexes, a change of partner, or a hefty water change using cooler water can provide a stimulus. But there are also pairs from which you never get as much as a single egg.

### Mops, peat, and Perlon

Woolen mops, peat fiber, and fine nylon thread are the spawning substrates normally used. The advantages of artificial substrates are obvious: they are more durable, can be used for a long time, and have no effect on water quality. The majority of breeders use dark woolen mops made of synthetic wool, which can be attached to a cork or other buoyant material so that they float in the water. The woolen threads should be long enough to extend down to the aquarium bottom, as many species like to spawn in the lower regions. Alternatively, the mop can simply be laid on the bottom. You need to check out where the fish prefer to spawn. Any second mop provided as cover for the female or as an alternative spawning site should have a different texture and/or color; some *Aphyosemion* are fussy in this respect.

It is sensible to make sure that there is no other material in the aquarium that might be used by the fishes as substrate, for example, Java Moss. Otherwise, finding the eggs may be difficult. Essentially, although the eggs can develop in the tank, it makes sense to look for them every day and store them separately. Many adults eat their eggs and the eggs often die off in the aquarium. But if they are transferred into a small bowl with very little water

(around 5 mm), they should develop well. One possible explanation may be that there is a better supply of oxygen for the eggs.

But it can also work the other way around: you can remove the adults after a few days and then leave the young in the breeding aquarium or container. If this variation proves successful, it is easier and often produces better results. But it doesn't work for all species, individuals, and aquarists. You must check it out for yourself.

### Hard eggs

The eggs have a diameter of around 0.8–1.5 mm and are clear to transparent yellowish or orange. They are slightly adhesive and so stick securely to the substrate. The eggshell is rather hard, so the eggs can be collected with the fingers. You quickly develop the necessary feel and eye for this.

Only eggs laid prematurely are still soft and burst when collected. It is helpful to briefly squeeze the spawning mop in a handkerchief in order to remove excess water. If you repeat this procedure several times, the eggs are then easier to find.

Sometimes the eggs are not fertilized or the larvae die well into the development phase. It is wise to find these dead eggs at an early stage and remove them with a pipette or an airline. Otherwise they will seriously pollute the water and infect other eggs. You need to distinguish between two forms of fungussing: on the one hand the eggs may be attacked from outside, and on the other they may die internally, in which case the fungus is only secondary.

Below: Here a whole group of *Aphyosemion australe* have been put to breed. The adult fish are left to spawn in the peat for a number of days and then removed.

It isn't unusual for the first eggs from young pairs to come to naught, but there are other problems that can lead to total loss of the eggs. Some young males don't

In this egg of an *Aphyosemion* species, the larva is already well developed. The eyes are clearly visible.



fertilize the eggs properly. The reasons for this are manifold and offer much room for speculation, but we won't venture onto that thin ice here.

When storing eggs in water, it is advisable to spot bad eggs as soon as possible and remove them with a pipette. Cloudy eggs shouldn't be put in the container—they will fungus almost immediately and may endanger the others. If the eggs are shaken up in the water, you will find that some eggs float for a noticeably long time before sinking to the bottom. These, too, are suspect. Healthy eggs, regardless of their stage of development, sink quickly.

In our experience, the storage container should have a shallow water level. This is thought to provide a better oxygen supply for the eggs because of the more favorable volume-surface ratio. The water should be only half a centimeter deep. We use 100 percent reverse-osmosis water, or perhaps add a minimal amount of tap water. You can also add a small piece of Sea Almond leaf, but the color of the water shouldn't become excessively yellow





Left, top to bottom:

The "Cape Lopez," *Aphyosemion australe*, here the normal form, is one of the few species that are bred commercially.

"Cape Lopez" males courting and displaying to a single female.

The female is already in spawning position; the males are still impeding each other.

oxygen supply. Alternatively, the airline can be fastened to the container with a clothespin so that the water's surface is constantly in motion. It is also important to cover the container so no dust can get in.

The temperature of the water is difficult to ascertain in such small amounts, but it is important to avoid major fluctuations. As long as the container is placed on the cover glass of the aquarium (provided it isn't an aquarium with a light hood), you should be sure of a good temperature range for the eggs.

The eggs will alter progressively over the days that follow, and using a magnifying glass you will be able to see the embryos inside. If an egg becomes noticeably dark and you can see the eyes of the fry using a magnifying glass, hatching may follow shortly. The fry usually manage to initiate this themselves.

If the fish don't hatch unaided, you can assist by adding cold water, shaking them in a small jar, or vigorous stirring. The old method of sprinkling a little flake food on the water's surface, so that the oxygen content of the water drops rapidly, can also trigger hatching. But in that case a complete water change is required immediately after hatching.

The fry swim free immediately after hatching and can generally also take small *Artemia* right away. Sometimes they don't fill their swimbladders with air and remain bellysliders all their lives. You should think very hard about rearing such specimens, as they probably won't be accepted as breeding partners. If there are a large number of bellysliders, you may still be able to obtain healthy young by adding an oxygen tablet or a small piece of one shortly after hatching.

### Dry storage

In addition to storing them in water, the eggs of non-annual species can be stored dry. This results in an even hatch rather than hatching being spread over a longer period, as is the case with storage in water. This has the advantage that you can rear a good number of fry together. You will need a fairly tight-closing container, for example a standard margarine tub, containing a



or the eggshells will harden and the larvae will die off inside. You will need to experiment to see whether the water needs to be changed daily for fresh or not. If the eggs are developing and not dying off, a water change in the storage container isn't necessary. The container can also be gently aerated in order to guarantee a better

layer of peat fiber, which should be moist enough that it won't dry out quickly, but not wet. It can be remoistened periodically with a spray bottle. The container should be labeled with the species name and the date the eggs were harvested.

Lay the eggs on the peat, trying to keep them from touching one another. This helps to avoid a fungussed egg infecting a neighboring one. Monitor the development of the eggs, and when you think that the hatching point may have been reached, add water to the container. If all has gone well, the majority of the fry will hatch. Or, the eggs can be picked out by hand and placed in fresh water, as peat consumes oxygen and must be laboriously separated from the larvae. Either way, it is worth storing the peat moist and adding water again a few days later.

Another method is to use peat fiber in the aquarium instead of a spawning mop, removing it after a few days and storing it moist in a plastic bag or lidded container. This avoids having to pick out the eggs by hand. You will have no idea how many eggs have been laid, but this is a simple and effective variant for readily bred species. In the case of recalcitrant species we would recommend the more labor-intensive, but more easily monitored method, which may well prove easier in the long run.

Which method works best depends on the circumstances and the skill of the aquarist. Everyone will find his or her own route to success.

The fry grow out fairly quickly. The size of the rearing container should be suited to the size of the fish. There is no advantage to a small number of fry in too large a container. The fish won't find the food as well, are often

timid, and don't grow well. Then again, lots of fish in a small container is not a good idea either, because they won't grow well.

### Problem areas

Sometimes the fish undergo long pauses in spawning and are then difficult to induce to spawn again. This isn't necessarily dependent on the food situation. For example, boredom can also lead to unwillingness to spawn. If you are keeping only one pair, there is no option to change partners, so other ways must be found to perk the fish up again, such as making a water change with noticeably cooler water. To amplify the effect you can also stop making water changes for a long time beforehand. In this way you can simulate the tropical dry season, during which the fish have to make do without fresh rain water.

Transfer to a completely different aquarium or spawning container can also help. Reluctant spawners should be separated and kept separate for at least a week. During this period the female should be fed heavily. The male should be fed somewhat more sparingly, or he may lose his sex drive and react only half-heartedly to the female.

It is also wise to consider from what region your *Aphyosemion* originated. From this you can evaluate whether your fish prefer cooler water or should be kept and bred in warmer water. If the species is from the lowlands or the savannas, then it will naturally prefer higher temperatures, which may mean a range of 73–77°F

Below: Spawning *Aphyosemion australe* penetrate a little way into the peat, release eggs, and spawn while lying close to each other.



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(23–25°C). If it comes from forest regions in the highlands, then the correct temperature range is 64–68°F (18–20°C).

If the fish came from near the coast, as is the case with *Aphyosemion australe* (Cape Lopez) or *Aphyosemion striatum* (Red-Lined Killifish), for example, this indicates warmer and not necessarily soft water. By contrast, the water in the mountain streams tends to be soft. Again, there are differences between rainforest and savanna areas.

A further hurdle to be reckoned with is the sex ratio among the offspring. This can prove extremely skewed, with up to 100 percent males or females. There are a number of factors that influence sex determination, but so far this has actually been proved only for individual species under very specific conditions. The most popular theory suggests that the sex ratio can be influenced to some extent by the maintenance temperature for the fry during the first two weeks. This actually works for some aquarists, but often only with particular species with particular parameters. Often their results cannot be repeated elsewhere.

Another method involves putting two fry at a time in a container and keeping them there by themselves for at least two weeks. This frequently produces a pair. Unfortunately, this method isn't reliable either, and also appears to be influenced by other factors. Often the sex ratio of offspring reared with the parents is more favorable than that in youngsters incubated externally.

### Species and crosses

The more closely *Aphyosemion* species are related to one another, the greater the likelihood that they will hybridize. Whether their offspring remain fertile over several generations is another matter. However, it cannot be stressed enough that creating hybrids makes no sense. The fish are already brightly colored enough; there is nothing to be optimized and molded, and crossing two species isn't a breeding achievement to write home about.

A not unimportant question for the beginner is, of course, which *Aphyosemion* he should start with and where he can get them. We will turn the first part of the question

around and mention the species groups with which you definitely shouldn't start—primarily those that come from cooler waters. It is easier to heat the water than to keep it permanently cool. Even without any influence from lighting and pumps, under living-room conditions temperatures will reach levels at which the fish won't necessarily be inclined to spawn.

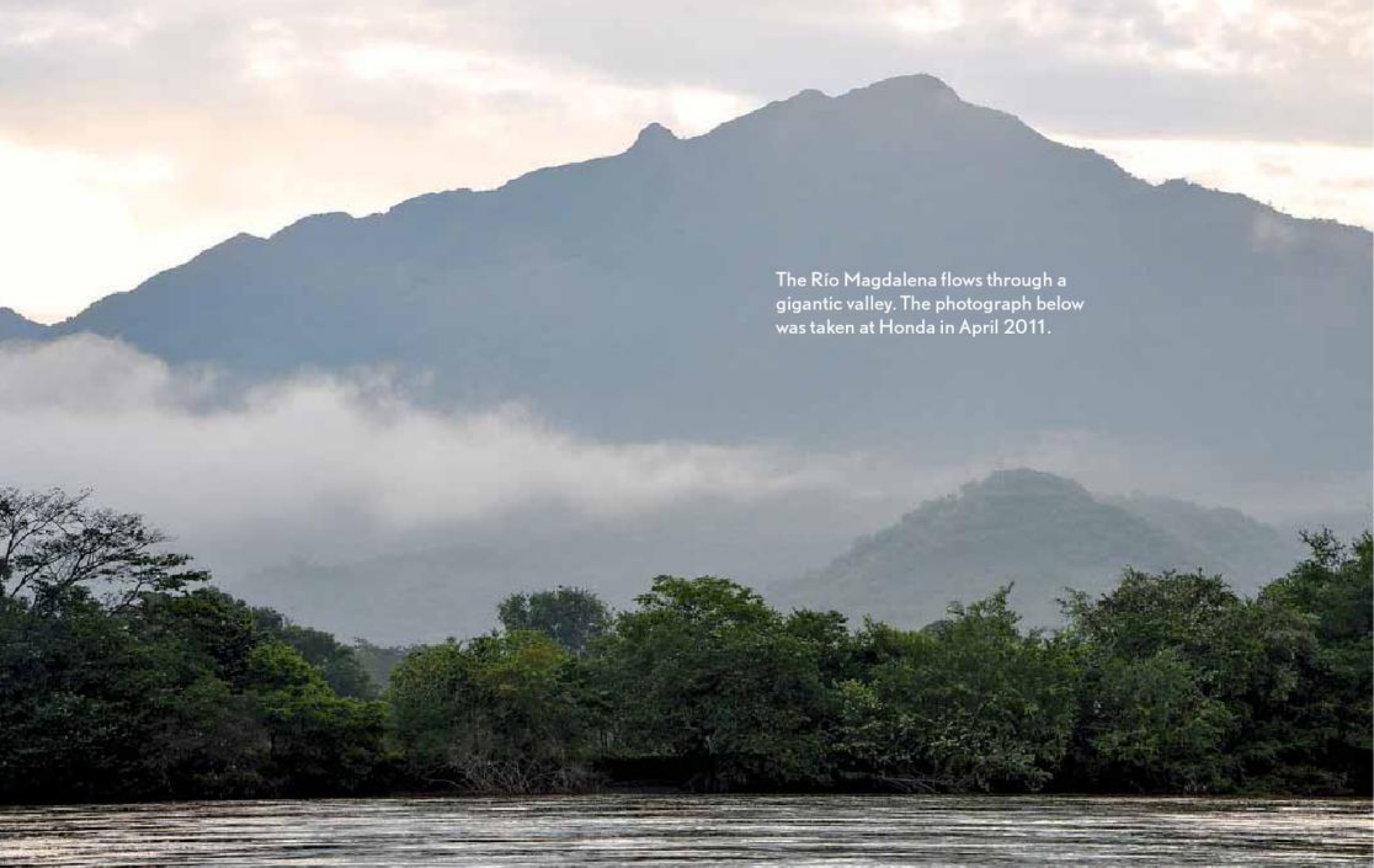
Recommended starter species include *Aphyosemion elberti*, *A. striatum*, *A. marginatum*, and *A. australe*. Listing possible additional species would be a waste of time, since they are not easy to find in the trade. Reliable sources include enthusiasts you find through your local fish store or aquarium society and online killifish club websites and forums. 🐟

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The Río Magdalena flows through a gigantic valley. The photograph below was taken at Honda in April 2011.



# In Search of the Blue-Eyed Plec



by Heiko Bleher • It was April 2011, and it had been over 20 years since my last visit to the Magdalena Valley. This time, my objective was to discover why the export of the Blue-Eyed Plec, *Panaque cochliodon*, from this region came to a standstill in the mid 1990s. What could have caused this sudden change?

For a long time the Blue-Eyed Plec, *Panaque cochliodon*, was sold incorrectly as *Panaque suttoni* in the aquarium hobby, and even called by this name in the scientific literature. The type locality of *P. cochliodon* is the Río Cauca in Colombia. Another species that purportedly has blue eyes is *Panaque suttunorum* from the Río Negro, Maracaibo Basin in Venezuela. *P. suttunorum* has not so far turned up in the aquarium trade, while the opposite is true of *P. cochliodon*. I first imported both sexes of this fish with the intense blue eyes as long ago as the late 1960s. These catfish were not very popular initially, but from the mid-1970s to around the mid-1990s it was virtually impossible to get enough of them.

The high losses among imports were attributable to the difficulty of transporting the specimens, which were usually large. There were virtually no specimens smaller than 6 inches (15 cm) total length caught, let alone shipped from Bogota, Colombia, the only export location.

I traveled on several occasions to the collecting area. Every time this involved a hellish journey down to the middle of the Magdalena drainage along one of the most winding and dangerous roads in South America.

The majority of Blue-Eyed Plecs were collected from Honda and Cambao. Drivers transported the fish from the Magdalena Valley, just a few hundred meters above sea level, to an altitude of almost 9,843 feet (3,000 m) in Bogota. I repeatedly tried to educate the collectors and drivers and asked them to be careful, but this didn't help much—most of the numerous exporters in Colombia shipped these beautiful fishes far too tightly packed and often still chilled.

You should know that an eternal spring, so to speak, rules in Bogota, and it is much too cold for all tropical fishes. The water temperature in the holding tanks of many exporters wasn't adequately monitored, and the fish, usually packed in simple cardboard boxes or just lying in the vehicle in plastic bags, were subjected to continually decreasing temperatures throughout the long journey up through the mountains. There was no question of quarantine in the randomly heated aquariums in Bogota, let alone the prophylactic treatment that might have increased the fish's chances of survival. Normally they were packed and exported right away.

## Travels in the Magdalena Valley

In Bogota I was greeted enthusiastically by my good friend Pedro Zea at Eldorado Airport, which has remained unchanged during the more than 40 years I have known it. Now, it is slated to be demolished. Pedro runs



The Blue-Eyed Plec got its name from the characteristic color of its eyes.



*Panaque cochliodon* from the Río Magdalena, near Cambao.



We caught *Hypostomus hondae* in the Río Magdalena near Cambao.

Right: This *Hypostomus* sp. was caught in the cast net.

what is hands-down the best export station in Colombia, which he established almost four decades ago near the town of Villavicencio in the warm Amazon basin. All of his fishes are acclimated for a month there before being shipped out.

Pedro had reserved a car for me, and his brother-in-law, Antonio Salamanca Barrera, was to be my companion. Every week for 15 years, Antonio transported 500–600 Blue-Eyed Plecs from the Magdalena Valley to Bogota for Orinoco Aquarium, but that ended in the mid-1990s. Antonio and Pedro, and most other exporters and importers, were convinced that the Blue-Eyed Plec had died out due to environmental destruction, so they were naturally very surprised that I had come to Colombia to look for it.

Below: This *Isorineloricaria* species, very likely undescribed, was a spectacular catch. This monotypic genus had been known only from the west Andean rivers of Ecuador.

The road was as full of bends as ever and though it was somewhat improved, there was a

corresponding increase in truck traffic. Many hours later we reached La Vega at an altitude of around 3,600 feet (1,100 m), a once-tiny village that has now grown into a veritable town. We then descended to 2,297 feet (700 m) and then climbed again to 5,249 feet (1,600 m), and it was evening before Honda, down in the Magdalena Valley, came into view. This town, too, has grown; it has now expanded to both sides of the eternally murky Magdalena, and the two parts are connected by an iron bridge. The old town has been very beautifully renovated, and we stayed in a nice little hotel there.



Adult *Panaque cochliodon* from San Martin de Loba.



### Poison

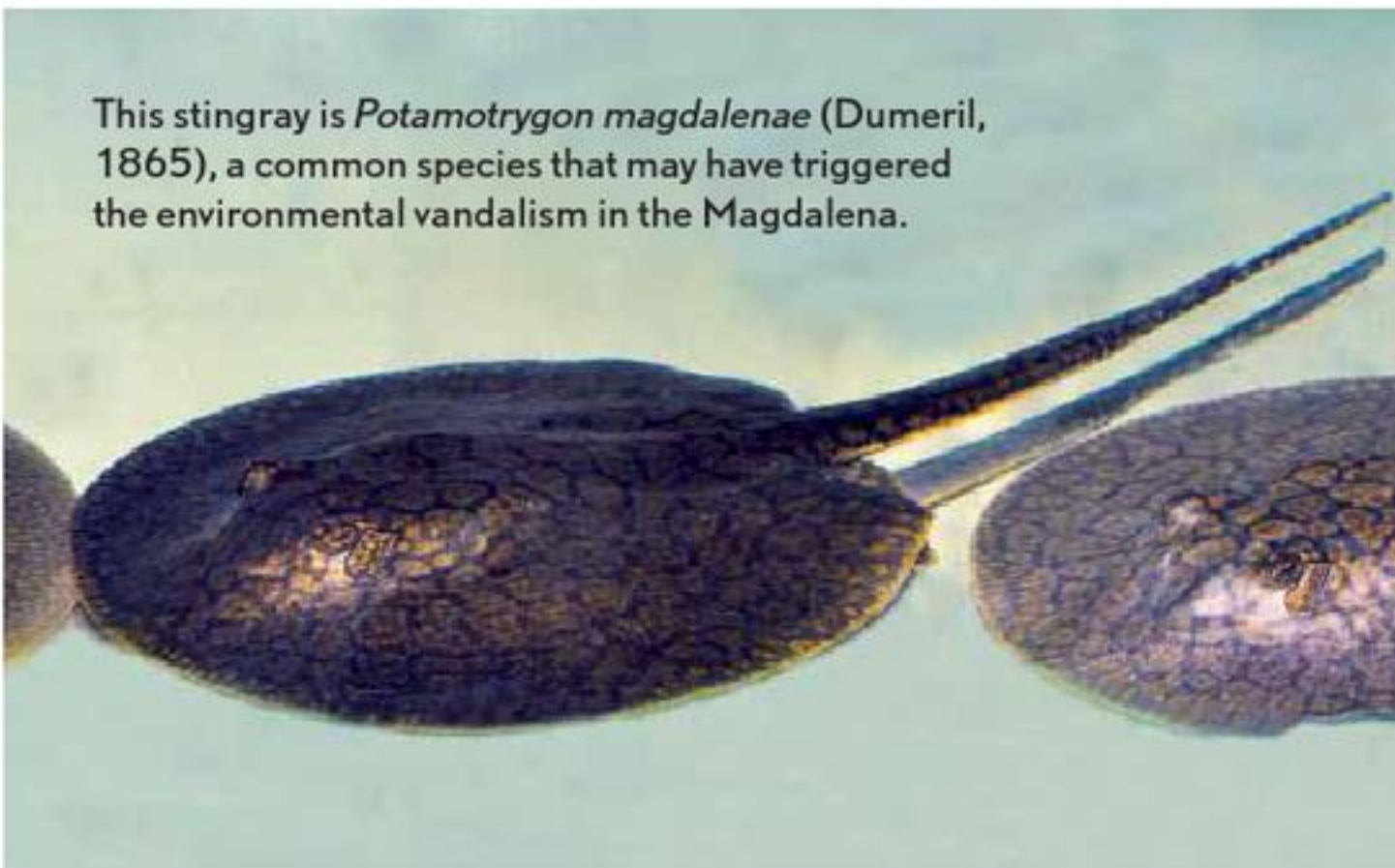
I wanted to seek out Antonio's fisherman contact right away the next morning. We made our way through narrow alleys, inquired all over the place, and eventually found his house a long way outside of town. I don't think he recognized me any more, but he knew Antonio, who had regularly purchased his fishes for 15 years. When I asked him about *cuchas de ojo azul*, he looked at me and said only that it would be easier to win the lottery than to find a *cucha*—there were none left and he had long since given up looking for them, since the "American millionaire had poisoned everything."

When I heard that, I was more than a little surprised, because even Antonio knew nothing about it.

The fisherman told us that a little over 12 years ago, an American was there visiting with his daughter. She was stung by a freshwater ray while swimming and fell into a coma. Her father thought he was going to lose his only child, and wanted to avenge her. He had experts develop a poison that would sink immediately in the water and kill the bottom-dwelling fishes—that is, the rays he hated. Tons of it were tipped into the upper course of the Magdalena and killed thousands of stingrays, as well as everything else that lived on the bottom, including the Blue-Eyed Plecs and seven or eight other loricariid species.

Local fishermen kept trying to catch *cuchas de ojos azul* for around two years, but without success. They gave

This stingray is *Potamotrygon magdalenae* (Dumeril, 1865), a common species that may have triggered the environmental vandalism in the Magdalena.



We also caught this ray. Is it a variant of *P. magdalenae* or a new species?





At the time of my visit, the Magdalena was full of catfishes of the family Pimelodidae, making their way upstream by the thousands.

up trying. In Cambao, further up the Magdalena, another fisherman, Jawel Gomes Perrera, and three others told me the same thing. The American had put the poison in the *represa* of the Lago Prado and the Magdalena had been full of dead fishes for weeks.

### A lighter variant

We spent two days in Cambao with Jawel, who nowadays catches only food fishes such as *Pseudoplatystoma*, *Ageneiosus*, *Pimelodus*, *Hypostomus*, *Cyphocharax*, and a *Leporinus* species. Nevertheless, he was prepared to accompany me in my search for *cuchas de ojos azul*. But we couldn't find any Blue-Eyed Plec. We didn't find anything in the Río Seco, either.

The story of the Blue-Eyed Plec is really tragic, and once again demonstrates what *Homo sapiens* is prepared to do to destroy aquatic fauna. I also made searches in the upper Río Magdalena in the Departamento del Huila, but without success. However, I did find a population of the Blue-Eyed Plec, albeit a lighter variant, in the Río Cauca in the vicinity of Tamalameque, before it empties into the Río Magdalena. This variant looks very similar to another blue-eyed species, *Cochliodon soniae* (L 137), which I found in the middle Tapajós many years ago.

This form doesn't have such a black body coloration as the form that formerly lived in the Magdalena. When I showed the owner of Stingray Aquarium my lighter-colored Blue-Eyed Plecs, he told me that the lighter form had also been brought back from the region of San Martin de Loba by his collectors.

A few specimens of this lighter variant from Colombia have been offered for sale—at \$250 U.S. each from Bogota—a serious price for serious catfish breeders only. The average aquarist will have to wait and hope. 🐟

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OPPOSITE PAGE, TOP: H.-G. EVERS; THE REST: H. BLEHER

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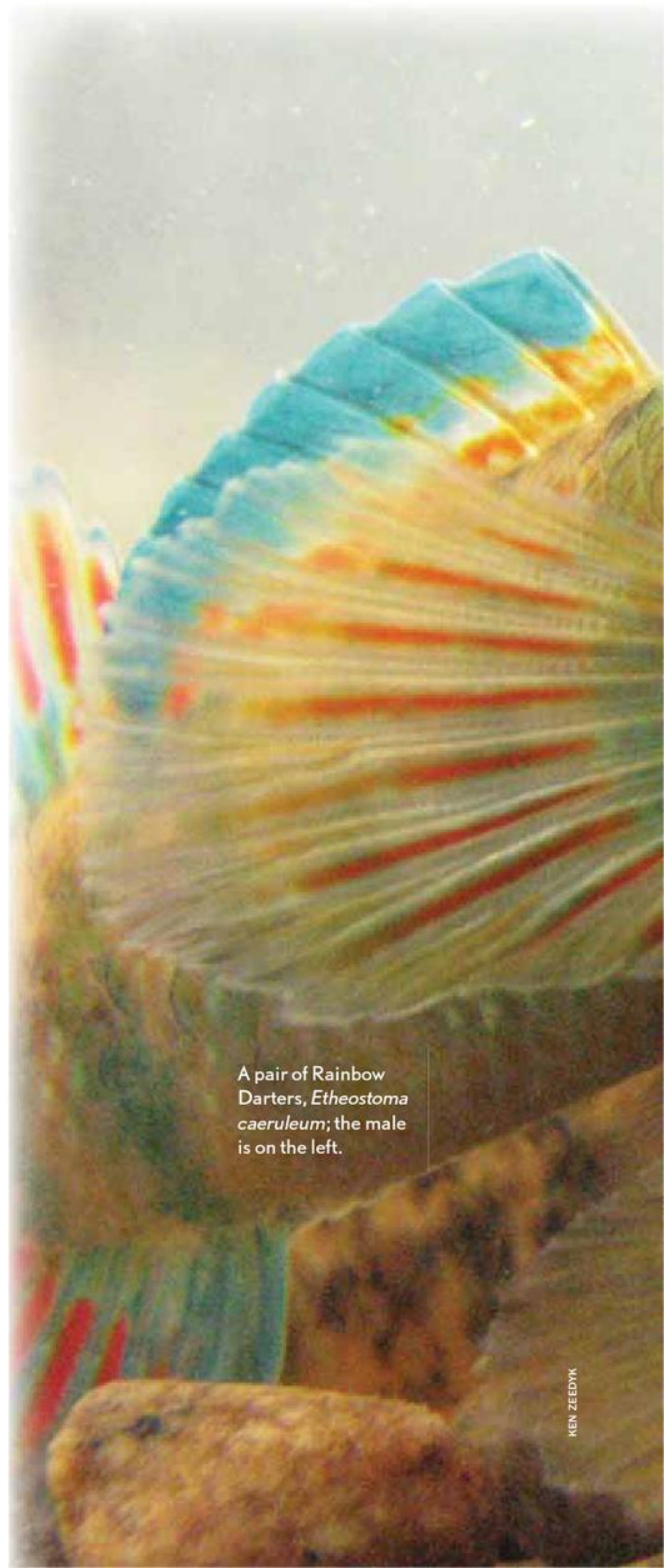
## A Native Jewel: *Etheostoma caeruleum*,

by Ken Zeedyk • The Rainbow Darter, *Etheostoma caeruleum*, is a beautiful and intriguing small fish native to North American rivers and streams. It is known to some hobbyists and the occasional fisherman, but most people in its native range are not aware that there is such an amazing beauty right in their own backyard. I have found that Rainbow Darters make hardy and very interesting aquarium inhabitants, and have even succeeded in breeding them. Males in full breeding color are among the most colorful of freshwater fishes, and look like they belong in the tropics rather than the cold, fast-flowing rivers and streams that they inhabit.



The author on a Rainbow Darter collection trip in Michigan.

Rainbow Darters are part of the Percidae family, which includes the popular game fishes the Walleye (*Sander vitreus*) and the Yellow Perch (*Perca flavescens*). While some members of this family are found in North America, Europe, and Eurasia, the *Etheostomini* subfamily of darters is exclusive to North America, predominantly east of the Continental Divide. The darter family comprises over 150 species, including the recently described spangled darter, *Etheostoma obama*, which is named after U.S. president Barack Obama, and is native to the Buffalo and Duck Rivers in central Tennessee. A



A pair of Rainbow Darters, *Etheostoma caeruleum*; the male is on the left.

# the Rainbow Darter





Rainbow Darter (male). The beauty of this native North American species rivals that of better known tropical fishes.

total of five new *Etheostoma* darter species were introduced in 2012, and all were named after United States presidents (and one former vice-president) in recognition of their leadership in the fields of conservation and environmental protection.

### The life of an American jewel

The Rainbow Darter's native range is predominantly across the Ohio and Mississippi River drainages, from northwestern New York, across southern Ontario, Canada, and as far west as Minnesota, where Lake Phalen, the only lake in which Rainbow Darters have been found, is located. To the south, their range extends into Arkansas and northern Alabama, with an isolated population in southwestern Mississippi. Introduced populations have become established in the Genesee and Fox River drainages in New York State. While *Etheostoma caeruleum* from different river drainages can be variable in color, at this time no subspecies are recognized. This would most likely change if the different Rainbow Darter populations were studied, so it is best to not mix darters from different locales.

Rainbow Darters inhabit areas of high water flow in second-order and larger streams and rivers. A second-order stream is one formed by two tributaries coming together into one stream, a third-order stream consists of three tributaries that have come together into a single stream, and so on. These darters are typically found over riffles or relatively shallow areas with larger rock substrates. They use these rocks as cover to hide from predators and as a shield from the current. They prefer waters that are slightly alkaline and moderately hard and stay relatively cool. Water temperatures in their preferred habitats in the north can vary from close to freezing to over 70°F (21°C). They share this habitat with various other *Etheostoma* and *Percina* darter species, chubs, and a number of dace and minnow species.

*Etheostoma caeruleum* is a micro-predator, feeding on aquatic insect larvae including those of midges, caddis

flies, mayflies, and black flies as well as consuming fish eggs and other small organisms. Their diet varies during the course of the year, depending on the availability of food resources and competition from other species. Rainbow Darters are relatively small, only reaching a length of 2.5–3 inches (6.4–7.6 cm) when fully grown, and their life expectancy in the wild is between two and three years. Females exhibit a small amount of color on the dorsal fin and on the flanks, which intensifies during the breeding season. Males in full breeding color are very gaudy when observed from the side, with blue cheeks, brilliantly colored fins, and banding on their flanks. However, observing these fish in their habitat can be quite challenging. Due to their bright coloring, one would think they would be easy to spot in nature, but when viewed from above their dorsal patterning blends into the substrate, and the activity for which they were named becomes evident as they dart from rock to rock in order to avoid capture. Rainbow Darters are opportunistically preyed upon by larger predatory fishes such as sculpins, trout, Smallmouth Bass, Stonecats, and Burbot.

### Gem hunting

Rainbow Darters can be obtained through specialized breeders found online, or they can be collected from their native habitat for individual use as regulations allow. Before venturing out to capture your own Rainbow Darters, be sure to know and follow the fishing rules and regulations of the state in which you are collecting. A fishing license is required, and a permit to collect and maintain native fishes may also be necessary. In some locations, collecting native fishes is prohibited altogether. Please respect the natural habitat, don't over-collect and risk depleting the natural breeding population, respect private property, and never transport fishes between drainages or release any captive animals back into the wild. Also, be sure to thoroughly clean and dry your collecting equipment in order to prevent the exchange of invasive plants and other harmful organisms between watersheds. In captivity the Rainbow Darter can live for three years or more, so be prepared to care for your captive fish for an extended length of time.

Collecting Rainbow Darters can be accomplished using a number of different techniques, any of which can be quite entertaining to watch. Two of the most popular

are collecting individually with a long-handled dip net, or in a group with a 4- to 8-foot wide seine net. Ideally, the dip net would have a 1/8-1/4-inch mesh bag supported by a square or triangular metal rim. A flat-edged rim allows the net to be placed securely on the stream bed. When collecting alone, a net handle of 4 feet or longer is helpful and can be used to help steady oneself in the current. The seine net should also be of 1/8-1/4-inch mesh, with floats on the upper edge and weights on the lower edge to keep it vertical in the water while being strung between two poles. Both methods require entering the river or stream, so a good pair of waders or hip boots is recommended, especially if the collecting trip occurs during the spring breeding season, when water temperatures are still in the 50°F (10°C) range.

Collecting individually requires a small or medium-sized long-handled dip net. The net is placed downstream from the collector behind a promising group of rocks and held with one hand. The collector then disturbs the rocks and substrate with his (or her) foot upstream of the net while balancing on the other foot. This flushes the

darters out of hiding and, typically, downstream into the net. As long as you don't lose your balance and fall into the cold water, this works quite well.

The group method of collecting requires a minimum of three people and a 4- to 8-foot seine net. Two people place the seine net into the stream, facing into the current and holding the handles at an angle, making a nice collecting pocket in the net. The third person moves upstream of the net and proceeds to do the "darter dance," which entails shuffling and kicking the feet rapidly across the substrate while moving in a zigzag pattern toward the



Shoal of Rainbow Darters in a native fish community tank maintained by the author.

Inset: colorful *Etheostoma caeruleum* male, fresh from the stream.





Collecting Rainbow Darters is best done with a team: Patrick Miller and Phillip Kukulski collaborate to capture the elusive darters in a Michigan stream.

net. The darters are flushed from hiding into the waiting net, and a number of them can be collected at one time using this method. Occasionally the “dancer” will lose his or her balance and end up taking a dip in the cold water, much to the enjoyment of the others.

### Bringing your treasures home

Personally, I have not experienced any problems transporting or acclimating newly collected Rainbow Darters, and they typically start feeding within a few hours of relocation. Proper transport entails bagging a small number of fish with clean river water into a thick 3–4-mil plastic or breather bag, then placing them in a cooler or other insulated container in order to keep them at a cool temperature. If the fish will be traveling for an extended period of time a battery-powered air pump may be used to circulate the water in the transport container. Typical acclimation procedures for aquarium fishes should be utilized, especially if the fish are going from very cool water into a home aquarium. Acclimating the fish to room temperature in an open bucket with an airstone and a drip line from the tank is sufficient.

### Showcasing your collection

Hiding places in the form of driftwood or rock caves are appreciated by these fish and make them feel more secure when first introduced to the aquarium, but once they have become accustomed to their new environment they soon learn to recognize their providers and approach the front glass of the aquarium in anticipation of a meal. Rainbow Darters are diurnal feeders upon benthic insect larvae, but will rise to take food from mid-water in the aquarium. They prefer frozen bloodworms, daphnia, and live blackworms and eat them with enthusiasm, and

these also work best in conditioning the fish for spawning. Some specimens eventually take prepared foods in the form of small pellets or flake, but they still prefer “real” foods. Placing the food into the current in the tank often helps to trigger a feeding response.

Provide their aquarium with clean, cool water and good current created by an external filter or internal powerhead, along with sufficient biological filtration, such as an air-driven sponge filter. The temperature of the water in which I housed my darters fluctuated between 68°F (20°C) in the summer to a low of 62°F (17°C) in the winter. This roughly corresponds with their high-end temperature range in the wild. I am fortunate to live in an area that draws its drinking water from Lake

Michigan, since this water chemistry has proven satisfactory for the darters. The water out of the tap has a pH of 7.5 and a hardness of 142 ppm. I perform 70 percent water changes every two weeks using dechlorinated tap water, and any detritus that has collected is removed at that time.

The substrate in the aquarium should consist of rounded, pea-size gravel up to a depth of 2 inches (5 cm), or if the aquarium is going to be used only for breeding, it can be left bare and a separate shallow dish or other container of gravel can be placed in the current where the female can deposit her eggs. I would recommend using gravel that is natural in color, similar to what you would see in the fish’s natural environment. In areas of softer water, dolomite may be added to the gravel, or a piece of limestone can be placed in the tank to increase water hardness.

### Increasing the bounty

Breeding occurs in the early spring, when the days lengthen and water temperatures rise. The females become visibly swollen with eggs when they are ready to spawn, and the males exhibit their most brilliant colors during this time. The males stake out small territories within preferred spawning areas, which is important to keep in mind if multiple males are housed together.

The easiest method for spawning Rainbow Darters in captivity is to collect a pair or trio of adult fish in early to mid-April and introduce them to an aquarium specifically set up for breeding. The spawning aquarium can be from 5 to 20 gallons (19–78 L) in size, depending on whether or not you will be pulling the eggs. A tight-fitting lid is recommended, and the aquarium may be lit with a fluorescent bulb if desired. Once the fish are acclimated

to their new surroundings, spawning should commence within a week.

The other option is to over-winter them in captivity, which was the method I chose. Over-winter conditioning entails a reduced photoperiod and lowered water temperatures, preferably into the 45–55°F (7–13°C) range for up to two months; however, I successfully conditioned them by dropping the temperature down to the low 60s Fahrenheit. Exposure to indirect outdoor light is beneficial, and based on my initial experiences this exposure to natural photoperiod fluctuations is a more important conditioner than a large drop in temperature. Many of the references to darter breeding that I have read list water temperature as an important conditioning factor for Rainbow Darters, but the water temperature in my spawning tank did not get below 60°F (16°C). The aquarium was exposed to natural lighting from south-facing windows, so the fish were exposed to natural fluctuations in the photoperiod. The females still became visibly swollen with eggs and the males colored up. I look forward to testing limited temperature drops and exposure to natural light cycles on other native fishes from my area.

### The making of new gems

Spawning is initiated when the female enters the spawning area. The male may or may not display to

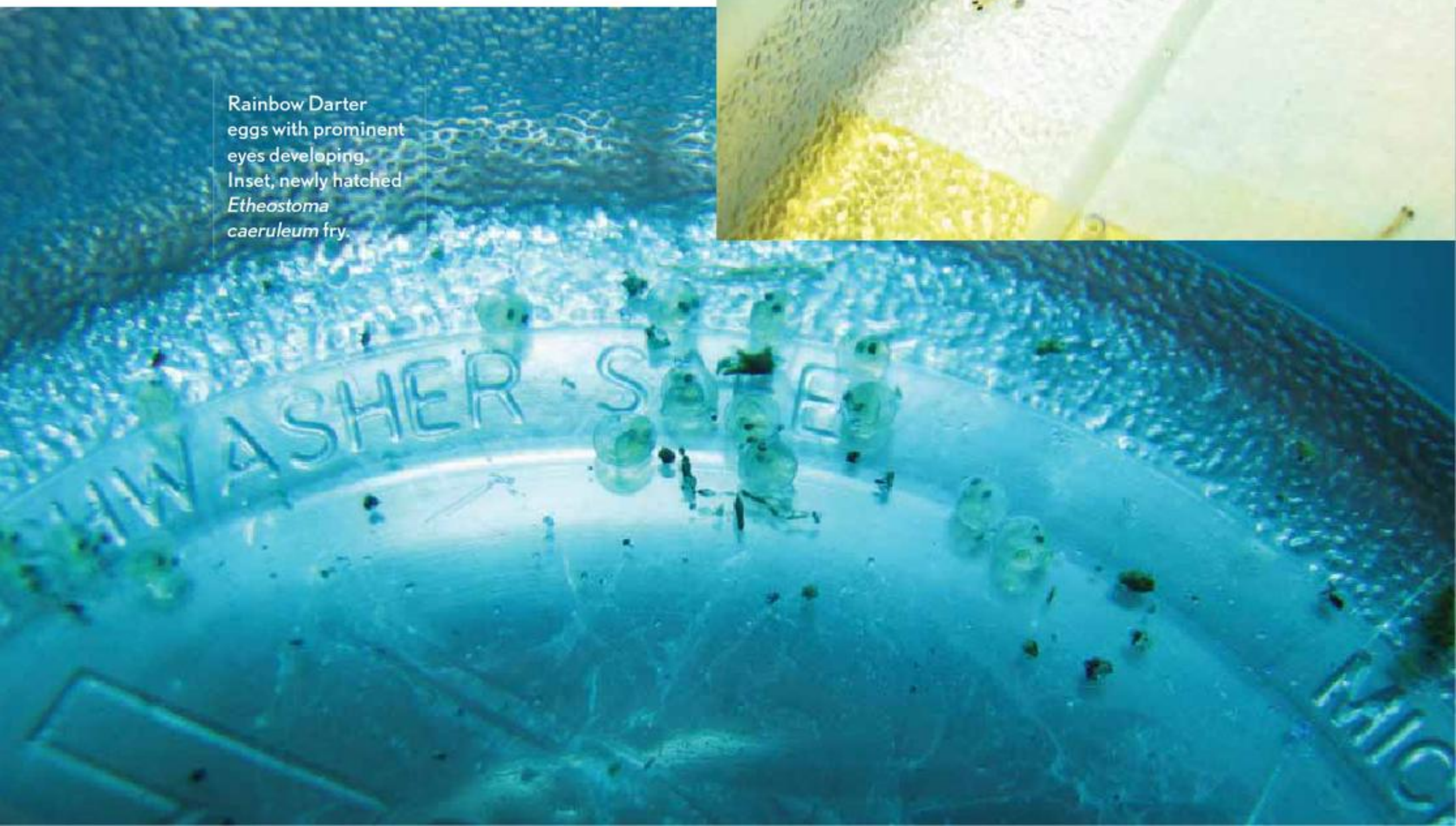


Post-spawning behavior in the author's Rainbow Darter aquarium.

her, but once she starts eyeing the substrate he becomes very interested and rushes to her side with his fins fully extended. The female dives head first into the gravel and pushes forward until just her snout and the top of her tail are exposed. She lays a small number of eggs in the



Rainbow Darter eggs with prominent eyes developing. Inset, newly hatched *Etheostoma caeruleum* fry.





In addition to their amazing colors and intriguing natural behaviors, these living jewels also have plenty of character and personality.

mature and the Iowa Darters spawn later in the year and deposit their eggs in floating vegetation and spawning mops. This native fish aquarium was quite entertaining to watch—the darters and dace could be frequently observed hopping and zipping throughout the aquarium looking for food and interacting.

### Reflections of an American jewel hunter

Experiencing these amazing and beautiful fish in my own “backyard” was, and still is, extremely rewarding. It has given me an even greater respect for the aquatic environments in my

gravel while the male fertilizes them from above. After spawning the female wriggles out of the gravel to rest.

Spawning occurs repeatedly over a number of days until the female has exhausted her egg supply, which usually averages around 300 eggs, depending on the size of the female. The eggs stick together in the gravel, which is a great preventative against being swept away in the current, and are thus easily collected, either using a gravel vacuum to siphon them out of the gravel or gently swirling the gravel and removing the adhesive eggs.

Rainbow Darter eggs can be hatched in a small container with an airstone and methylene blue as a fungicide. An alternative is to remove the spawning adults and let the eggs hatch out in the spawning aquarium. The eggs hatch in 10 to 14 days, depending on temperature, and the development of the young fish may be witnessed through the clear eggs, with the eyes of the developing fry being readily visible. Newly hatched darter fry can be raised on brine shrimp nauplii and other small live foods, such as microworms. I found the eggs to have a very good hatch rate, and fry survival was also good. Clean water and frequent feedings were very important to long-term fry survival.

### Native tankmates

Other residents that I have kept in aquariums with Rainbow Darters include Iowa Darters (*Etheostoma exile*), Northern Redbelly Dace (*Phoxinus eos*), Brook Sticklebacks (*Culaea inconstans*), Western Blacknose Dace (*Rhinichthys obtusus*), and small immature Blackside Darters (*Percina maculata*). The Brook Sticklebacks and Iowa Darters also spawned while in the same aquarium with the Rainbow Darters. I was not concerned about cross-breeding, since the Blackside Darters were im-

area, and also has raised concerns over the troubles facing our native fishes. Siltation, habitat destruction, and pollution, as well as the introduction of non-native fishes and invertebrates, are constant threats to the darters’ natural habitats. One oil or chemical spill into a small tributary or waterway can have long-lasting effects on the fish population. Not only are the fish directly harmed, but their food source of aquatic insects is lost.

In my home state of Michigan the Round Goby (*Neogobius melanostomus*) has spread through many of the waterways and can be easily caught by hook and line or net. This non-native invader competes with darters for habitat and food resources, and in areas of the river near my home I can catch 10 gobies to every 1 Blackside Darter. Fortunately, I have yet to find one of these gobies in the same locations where I have found and observed Rainbow Darters, so I hope that our beautiful little native fish occupies a niche not suited to these unwelcome intruders.

Rainbow Darters are amazing fish with wonderful colors and fascinating behaviors, and they well deserve a place in the hobbyist’s fish room. They are very interesting to observe in the aquarium, and often appear to tilt their heads while observing their keepers, implying a level of intelligence and awareness similar to that which I’ve seen in some cichlids I have kept. I feel fortunate to live in a region inhabited by such a fish, and believe it deserves to be considered a North American jewel. 🐟

**Ken Zeedyk** has been keeping fish off and on for more than 30 years. He is a fellow of the Grand Valley Aquarium Club (GVAC) in Grand Rapids, Michigan, and has bred more than 120 species of freshwater fishes and invertebrates and cultured a number of aquatic plant species. Zeedyk and his family reside in Zeeland, Michigan.



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## Tadpole shrimp in the aquarium

Above: An adult specimen of *Triops cancriformis cancriformis* from Spain. This local variant is lighter colored than those often seen for sale.

by *Timm Adam* • They have been shunned for many years by serious aquarists, but there is now growing interest in a group of freshwater invertebrates with unbroken living links to the age of the dinosaurs: the tadpole or shield shrimp of the genera *Triops* and *Lepidurus*. In addition to *Triops longicaudatus*, which has been sold in toy stores and natural history supply houses (sometimes as “Dinosaur Shrimp” or “Microsaurs”) for many decades, several other species, subspecies, and morphs have become available. For aquarists ready to try something totally new—and yet absolutely ancient—here is an introduction to these fascinating primordial crustaceans.

One fact alone justifies the fascination with tadpole shrimp: *Triops cancriformis* has been around almost unchanged for about 220 million years, as seen in many fossil images circulating on the Internet. The fossil species was described as a subspecies of *Triops cancriformis*, namely *Triops cancriformis minor*.

*Triops* can be kept and observed with relatively little effort over very long periods of time. Even “rest periods” of dormancy for years or decades are tolerated by this crustacean. What fish species could endure such a lifestyle? Even among freshwater inverts you won’t find many that would tolerate such treatment.

One fact must be noted: not all *Triops* are made equal. Their habitats are as variable as their ways of life, so their care requirements vary as well. The three commonly available hobby strains—*Triops longicaudatus* from

the U.S. (I call it the “toy-store strain”), *T. cancriformis cancriformis* from a biotope on the river March in Austria (distributed by Dr. Erich Eder), and *Triops* cf. *newberryi* from Queensland, Australia (a strain distributed by Billa-bong Bugs)—might be maintained indefinitely under very simple conditions. With other strains, it can be difficult to establish a stable population in the aquarium for long periods of time.

### Legs for every purpose

*Triops* are “basic” crustaceans and do everything—breathing, moving, digging, and feeding—with their specialized legs. Their curious movements—flips, rollovers, body curls, swimming belly side up—make them fascinating to watch, all thanks to the power of their appendages. Even the cysts for their reproduction are stored in a pouch

Right: Typical habitat of *Triops* in Australia. The top picture was taken in June when the depression was filled with water. The bottom picture shows the same biotope in April of the following year, during the dry season.

on the 11th pair of legs, which is adapted for this purpose. Up to 70 pairs of legs and 44 body segments are seen in tadpole shrimp. On the first 12 body segments there are only one pair of legs each, while further back there can be up to 10 pairs per segment, and the last few segments usually have no legs.

Crustaceans have mandibles as mouthparts to chew food and two pairs of antennae. These two characteristics are sufficient to differentiate the tadpole shrimp from the *Xiphosura* or horseshoe crabs, which have a similar appearance.

However, the four surviving species of the family Limulidae belong to the Chelicerata (spiders, scorpions, and sea spiders) and have chelicerae as mouthparts and no antennae.

The genus name *Triops* stems from the three eyes found at the front of the carapace, or shield. The two larger ones are complex eyes; the middle one is a so-called nauplia eye. Interestingly, the eye design may permit the animal to detect light coming from below. Also worth mentioning is the oxygen-transporting hemoglobin that is dissolved in the hemolymph (blood analog of arthropods) of *Triops*. The intense red color often observed in *Triops longicaudatus* in the aquarium is due to this protein.

### Heterosexuals, hermaphrodites, and virgins

The main survival advantage of *Triops* is their efficient reproduction. Many populations consist entirely of hermaphrodites (organisms that have both male and female reproductive organs in the same individual) or females that reproduce by parthenogenesis (development of an embryo from an unfertilized egg cell). In *Triops longicaudatus* it was observed that 594 cysts were deposited within 72 hours (Gruner 1993). I have to assume similarly high numbers in other *Triops* strains that reproduce by parthenogenesis or through self-fertilization. For example, two to three days after adding water to an aquarium of about 32 gallons (115 L), myriad nauplius larvae and molted instar stages of *Triops cancriformis cancriformis* were observed. In *Triops* cf. *newberryi* from Australia, within 24 hours after adding water to a dry tank with resting cysts, masses of larvae hatched. It is possible to raise 40 of these up to a size of 2 inches (5 cm) in a 15-gallon (55-L) aquarium within a week's time.

Reproduction in captivity is usually less productive in available *Triops* species and strains, which propagate conventionally via two sexes and copulation. With *Triops*



*australiensis australiensis* and *T. granarius*, I have never encountered as many hatching larvae in the first three filial generations as with the species above. However, they seem to reproduce at a high rate in nature as well, given the larger expanses of available habitat. In the wild, there are lots of developing animals present and therefore always plenty of sexual partners, which might represent a bottleneck in captivity.

In summary, *Triops* possess all the possible reproductive strategies known to science: sexual (gonochoric, or one sex per individual), self-fertilization in hermaphrodites, and parthenogenesis of females. Moreover, all three strategies may be observed within one species in biotopes found in the same region (Garcia-Velazco 2009).

### Glass or Plexiglas

Glass aquariums are the most convenient way to house *Triops*. I used to buy 12-gallon (45-L) tank sets that measured 20 inches (50 cm) long, 12 inches (30 cm) wide, and 12 inches (30 cm) high. For some years now, the



On this recently deceased adult *Triops australiensis australiensis* the cysts are visible through the egg sacs.



Large specimen of *Triops cancriformis cancriformis*. This animal stems from a strain distributed by Dr. Erich Eder from the river March, near Angern, Austria.

12-gallon kits have not been available and I have started to convert to the 15-gallon (55-L), 24-inch (60-cm) starter sets (24 x 12 x 12 inches/60 x 30 x 30 cm). These kits have the advantage that they are relatively inexpensive and include a hood with a light and a heater. Individually purchased, the components would cost more. The internal filters included in these kits are not suitable for *Triops* husbandry, but will certainly find another application in the fish room. As for the size of the tanks, I can only reiterate that bigger is better, especially with regard to the footprint; however, since most readers will work with standard tanks, the footprint is fixed. Instead of tanks, other glass containers can serve as *Triops* habitats: for example, large vases or bowls, or plastic containers of various kinds. However, in many plastic vessels, the long-term care of *Triops* fails. This might be due to softeners or other chemicals that are added to some plastics and affect the *Triops* negatively. I have had luck so far with mortar buckets, the familiar Exo Terra Faunarium (plastic terrarium), and fauna boxes from Hagen.

As a substrate I use common aquarium sand with

the finest particle size. With my first strain of *T. cancriformis cancriformis* I used soil from the garden, which is rich in clay and sand. However, for a first trial, I now recommend a clean substrate without too many fine particles, which tend to cloud the water and make it difficult to observe the animals. Once a population flourishes, you can experiment with various sand types or other natural substrates.

### Salt or no salt?

Distilled water, commercially available from the supermarket or hardware store, is the best option for starting a culture of *Triops*. This guarantees a high hatch rate, and you can be assured that there are no toxic elements or microorganisms present. Once a culture is performing well, you can experiment with other water sources, such as rainwater, filtered pond water, or even tap water if it contains no heavy metals or chlorine or if you have used a water conditioner.

To start a culture with a new *Triops* strain, it is helpful to research the water conditions in that strain's natural biotope. Some populations apparently tolerate or even require various salts and trace elements in their water (not only sodium chloride). From the island of Malta there is a population of *Triops cancriformis* known to live in brackish water (Lanfrano et al. 1991). If you attempt to hatch cysts from such habitats in distilled water, failure is certain. However, for the "toy strain" of *Triops longicaudatus*, *Triops cancriformis cancriformis* from Central Europe, and *Triops* cf. *newberryi* from Queensland, I recommend starting the culture with distilled water.

### Not made for short days

Shrimp of the genus *Triops* require about 12 hours of daylight to develop. Thus, unless you keep them only during the spring or summer outside or near a window, artificial lighting must be provided. A timer is recommended. For a light source, all ordinary fluorescent, halogen, LED, and incandescent light bulbs will work. The water temperature should be close to that found in the natural biotope. *Triops cancriformis cancriformis* requires about 59°F (15°C) to hatch and adults tolerate even lower water temperatures. *Triops longicaudatus* develops best between room temperature and up to 77°F (25°C). *Triops* cf. *newberryi* from Queensland is best kept at 84°F (29°C), and with good nutrition reaches a size of 2.5 inches (6 cm) within 10 days. Since these animals are very tolerant in terms of temperature, 77°F (25°C) or warmer is sufficient. Longhurst (1955) kept and reproduced *Triops australiensis*, *T. cancriformis*, *T. granarius*, and *T. longicaudatus*, as well as *Lepidurus apus* and *L. arcticus*, at 68°F (20°C).

Aeration of the tank can be achieved by using an air stone connected to a small air pump, but a sponge filter connected to a medium sized air pump maintains better water quality.

### Omnivores

I have found that for almost every strain of tadpole shrimp, ordinary flake food is suitable. For the first larval stages, small feed that contains *Spirulina* algae and animal ingredients normally used for fish larvae or to culture baby brine shrimp has worked well. Larvae in larger stages will consume almost anything: dried fallen tree leaves, vegetables, silkworm casings, fish food tablets, and live foods such as *Artemia*, *Daphnia*, and bloodworms, to name just a few.

Since *Triops* are true omnivores, they will also consume live plants; therefore, it is difficult to maintain a planted tank with tadpole shrimp in it for long. However, there is one plant that works well for the *Triops* aquarium: duckweed, *Lemna minor*. Although the duckweed is eaten, the plant's fast growth rate permits its survival and it helps absorb excess nutrients from the water.

As in fish aquariums, any decorations should be carefully assessed for toxic substances. Many plastics appear to release toxins, to which these shrimp are very sensitive. However, natural driftwood such as that used for fish tanks is very suitable. Various natural stones can be used to add structure and replicate natural biotopes.

Keeping *Triops* with other animals is a challenge; one should not forget that they will eat any smaller animal and even each other. Conversely, larger company might regard the *Triops* as food. Fish are generally unsuitable as tankmates, but various snails are perfect because they are common in the natural habitats. In nature-like biotopes of *Triops cancriformis cancriformis* the great pond snail *Lymnaea stagnalis*, and possibly other snails, can be found. In one of my larger aquariums, the water louse *Asellus aquaticus* lives together with *Triops cancriformis*.

### Seasonal shrimp

I would like to report how I have achieved the best success in terms of the number and size of adults I was able to raise. An aquarium of at least 10 gallons (38 L) is first equipped with 6-10 pounds (3-5 kg) of aquarium sand, a light with timer, and a heater, if necessary. After adding dis-



This cyst-laying individual probably belongs to a form of *Triops newberryi*.

tilled water, we wait until the temperature has stabilized where we want it to be. Then we can add the cysts or the sand containing the cysts. With *Triops longicaudatus*, *T. newberryi*, *T. australiensis*, and *T. granarius* the first hatched nauplii are found within 24 hours; *Triops cancriformis* might require a little more time.



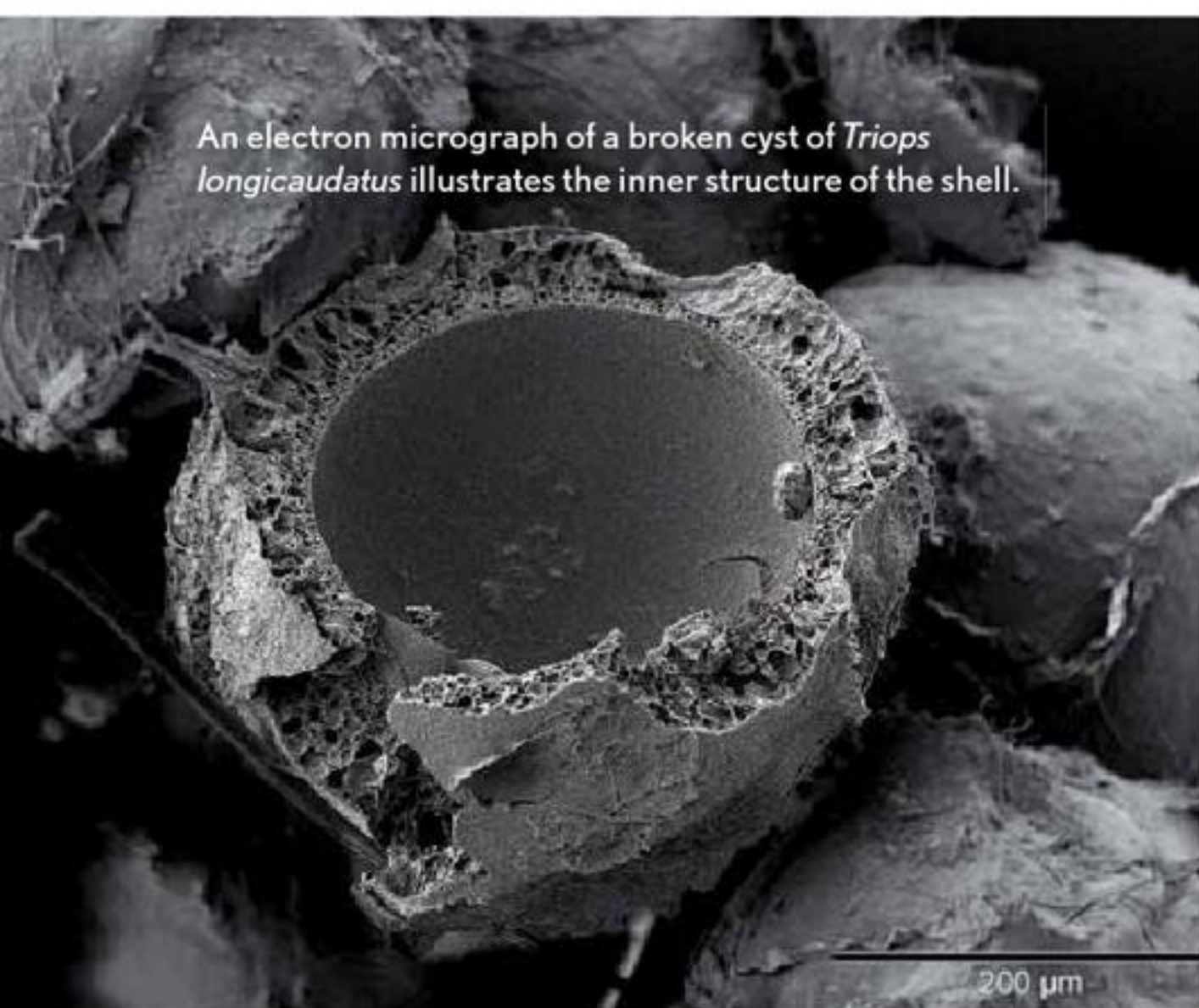
Pair of *Triops granarius* from Japan. The sexing is straightforward: the male (right) has a rounder shield and is brighter and more uniformly colored than the female.



An adult male of a variant of *Triops longicaudatus* from the U.S. This strain has a high male to female ratio.

The first nauplius stage does not forage for food. Consequently, it is better to wait on feeding until after the first molt. Finely powdered food works well for brine shrimp or baby fishes, but it is only required for a short time as these shrimp grow very fast. After a few days, ground flake food can be used. Given that the *Triops* tank usually has no filtration other than a sponge filter, the water quality must be maintained by balancing careful feeding with regular water changes.

The amounts of food are difficult to specify, since it depends on the number of hatched animals you are keeping and the size of the tank. It is best to feed in small amounts several times a day. After all the shrimp have grown up, spawned, and died off and no more shrimp are hatching, I usually wait for two weeks and then drain the



An electron micrograph of a broken cyst of *Triops longicaudatus* illustrates the inner structure of the shell.

tank. Simply leave the tank in its place and let it totally dry up. About two months after the tank has completely dried out and the cysts have been dormant, the next generation can be hatched out by adding water again. It is wise to set aside a large batch of sand from the tank beforehand, so that if something goes wrong you will have some cysts in reserve for another attempt.

After growing several generations successfully in the same tank, it is time to experiment. Split the substrate into various tanks and containers, place them in multiple locations, and use different water temperatures and conditions and evaluate the best circumstances in your setting.

### Species and strains

*Triops cancriformis cancriformis* (Bosc 1801) is a European species that was distributed for many years by Dr. Erich Eder. The original animals or cysts came from a biotope on the river March near Angern, Austria, that was later filled in. Offspring of this strain are kept by many hobby-

ists and are widely available online.

*Triops cancriformis simplex* (Ghigi 1921) and *T. cancriformis mauritanicus* (Ghigi 1921) are kept by scientists and a few hobby breeders. Korn et al. (2006) argued in their publication that *T. mauritanicus* should be considered a valid species rather than a subspecies of *cancriformis*, because it is genetically distinct from *T. cancriformis cancriformis*.

*Triops longicaudatus* (LeConte 1846) is distributed worldwide by Toyops, a U.S. company. Aside from that strain, whose origin I was not able to pin down, I have a population from Kansas, a gonochoric variant (reproducing sexually) also from Kansas, plus another form from Japan that differs morphologically.

One often reads that *T. longicaudatus* is not a valid species, which is not true. It has become clear that there are likely several subspecies of *T. longicaudatus* in the U.S. It is possible that companies or individuals in the U.S. have accidentally mixed several populations and then distributed them. Hybrids may also have resulted from accidental contamination by moving sand or soil around the country.

In his revision of the genus, Longhurst (1955) differentiated two subspecies, *Triops longicaudatus longicaudatus* and *T. longicaudatus intermedius*. However, his work was virtually ignored in subsequent years. *T. longicaudatus* was unquestionably described by LeConte in 1846. Whether the animals we keep at the moment belong to this species or should be differentiated into multiple species or subspecies is another question.

*Triops australiensis australiensis* (Spencer and Hall 1895) is not very commonly available. Animals of this strain, which indeed originated from Queensland in Australia, are very closely related or even genetically identical to *Triops newberryi* from the U.S. How this was possible might never be fully explained. I keep three different strains of *T. australiensis australiensis*. But like other sexually reproducing forms in captivity, their continued maintenance can fail easily. *Triops australiensis australiensis* faces the same dilemma as *T. longicaudatus*: all known populations were labeled as or determined to be *T. australiensis australiensis*, but it is a fact that there are several forms of *Triops* in Australia that differ from each other, morphologically as well as genetically.

*Triops granarius* (Lucas 1864) became available only recently. The strain originates from a population in Japan. This species reproduces only sexually. What are missing in Europe are strains of *T. granarius* from Africa, since this species evidently occurs both in Asia and Africa, as *Triops numidicus* is now a synonym of *T. granarius*, therefore no longer a valid species (Korn and Hundsdoerfer 2006).

*Triops newberryi* (Packard 1871) from the U.S. is firmly established in the hobby. Maintenance of this species is as easy as that of *T. longicaudatus*.

*Triops australiensis sakalavus* (Nobili 1905) from Mad-

agascar seems to have vanished from captivity; neither scientists nor hobbyists have reported them in a while.

In summary, a revision of the genus *Triops* is long overdue. New genetic insights show that the current classification of species and subspecies should be reevaluated. It can be argued that the diversity of *Triops* is greater than has been assumed so far. But given the lack of a unanimous opinion among scientists, it is not surprising that the situation in the hobby is even more problematic. Most amateurs are not familiar with the details about systematics and evolution and even less familiar with genetics. However, each *Triops* enthusiast has a responsibility to follow certain guidelines.

### An appeal

Please, never mix strains from various locations, even if you think they are the same species. When you trade cysts, always accompany them with all the information you have, including detailed location names or GPS data (not just the country), date of collection of the animals or cysts, who collected them, and who has determined the species. And, most important, never discard substrate that might contain cysts of *Triops* outside, since they could become established outside their natural range! 🐟

**Acknowledgments:** I would like to thank a few people who have supported and facilitated my personal exploration of the tadpole shrimps: Dr. Erich Eder, Claus Wurst, Christoph Seiler, and Michael Korn. Special thanks to Dr. Brian Timms for everything he shared with me and to Don Dasis for trading many strains of *Triops* and *Lepidurus*. I thank my wife, Sabine Adam, for her patience with my many tanks and her ongoing support of my hobby.

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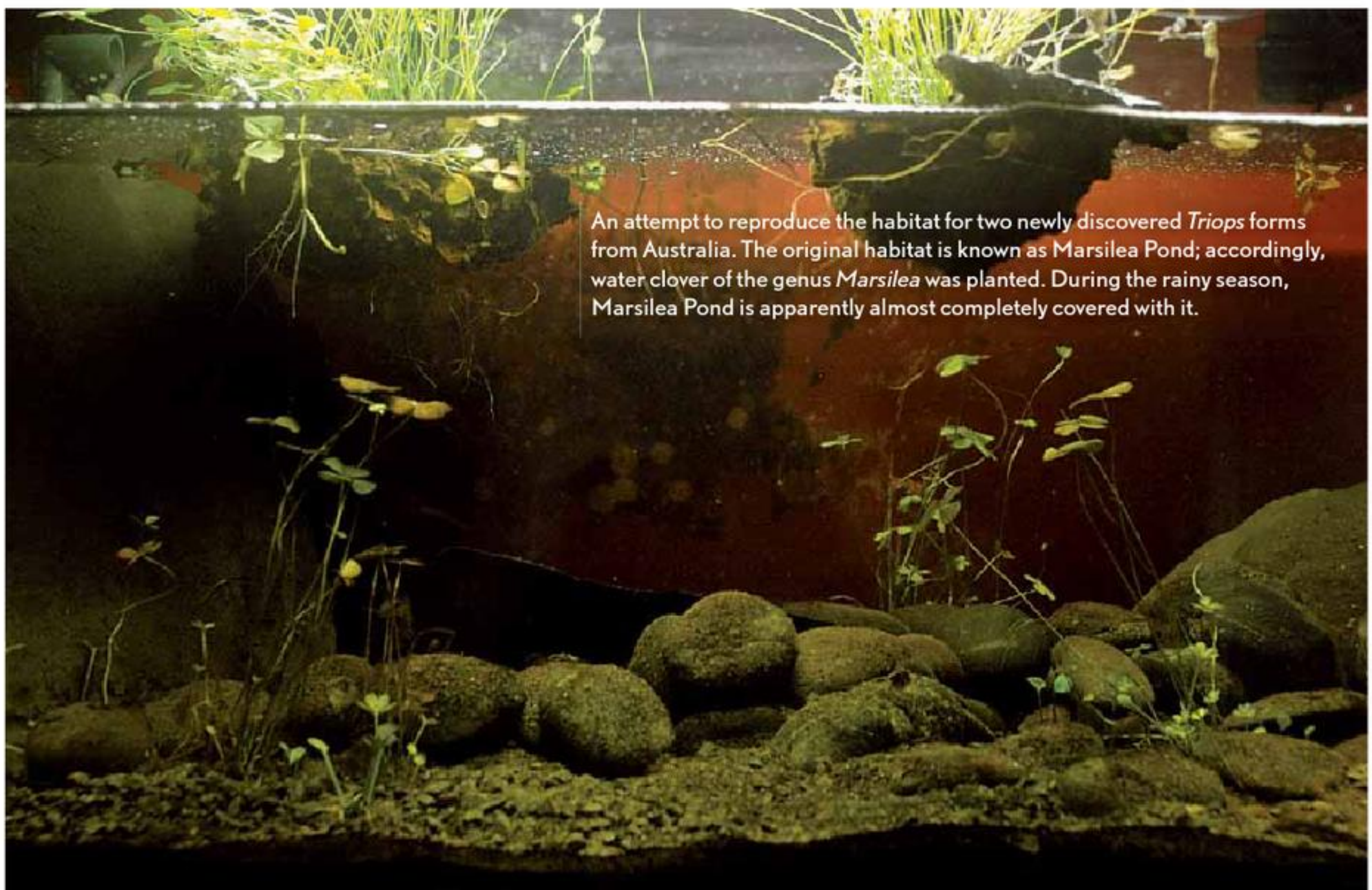
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### ON THE INTERNET

[www.urzeitkrebse.at](http://www.urzeitkrebse.at) (in German; English translation available).

### SOURCES

<http://www.toyops.com>  
<http://thetriopsforum.com>



An attempt to reproduce the habitat for two newly discovered *Triops* forms from Australia. The original habitat is known as Marsilea Pond; accordingly, water clover of the genus *Marsilea* was planted. During the rainy season, Marsilea Pond is apparently almost completely covered with it.

# Shedding new light on a planted aquarium

by Thomas Hörning; images by Hans-Georg Evers • It was November 2011. I had an empty wall space in my basement fish room—a luxury that stimulates the imagination of every aquarist. Should I install shelves for breeding, a few medium-sized tanks, or a container pond? I chose a big tank with a large footprint—over 7 feet long (220 cm). But how should I light it?

The support for the tank was built with bricks and mortar, with space for a filter sump and a 60-gallon (240-L) grow-out tank. Everything went according to plan, but the last step—the lights—caused some headaches. How could I illuminate such a large tank in a way that was both cost-effective and visually pleasing? With the usual T8 or T5 fluorescent bulbs, or with the newest technology—LED?

Opinions about LEDs are still all over the map. Some balk at the higher purchase price, others consider the light “weird” or unfamiliar. And the technology, everyone agrees, may not have fully matured yet. Knowing all this did not help with my decision; I was tempted to try LED lighting for the first time, but unsure if I should take the plunge.

Finally, thanks to my friend Hans-Georg Evers, I came into contact with Lars Fehlandt and his company, ECONLUX. I told Lars about my tank, the intended fish stock (my primary passion: rainbowfishes that would thrive with all that swimming room), and the many plants.

My intention was to make the tank an eye-catcher with attractive planted aquascaping, which, I realized, would take time. I wanted to document the plant growth and gather experience with LEDs over a long period of time, then report on my results. Practical reports with the actual experiences of real aquarists happen to appeal to me much more than theoretical discourses on the science of new aquarium technologies with impressive but, unfortunately, often unhelpful technical details. For me this big tank, with a volume of more than 1,000 liters (280 gallons) and a footprint of 220 x 80 x 60 cm (87 x 32 x 24 inches), was a chance to experiment and see the results first-hand.

## Pendant lights and strips

After a flurry of phone calls and emails, Lars Fehlandt sent me a long-awaited package containing three pendant spotlights, each with an LED-universal module (25 w, 6,500 Kelvin) and a reflector set (36°). In addition, there were four

Opposite page, top: The aquarium shortly after the initial planting in November 2011.

Middle: Four months later, the fast-growing stem plants were growing well, but because of the fish waste, the first algae problems began.

Bottom: By the summer of 2012, seven months later, the aquarium had become a real jewel. The algae were gone, and in addition to the stem plants, rosette plants were starting to enhance the look.





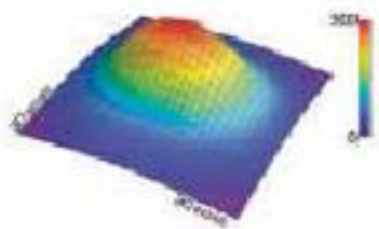
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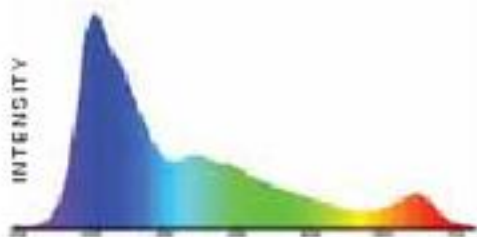
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44-inch (110-cm) LED SunStrips in the light-color "Plant-Coral" (each 22 w). The pendants were hung with chains over the tank, along the center line. The chains make it possible to change the height of the lights. Pairs of connected SunStrips were placed directly on the glass covers on the front and back of the tank. According to Lars, the expert, an open tank with free-hanging lights would be better, since the 4-mm glass reflects some of the light. However, with rainbowfishes that chase every fly and can be jumpy, an uncovered tank was not an option. The aquarium was decorated with brown gravel and an initial planting of fast-growing plants. I left out a substrate fertilizer, but I opted for a CO<sub>2</sub> dosing system.

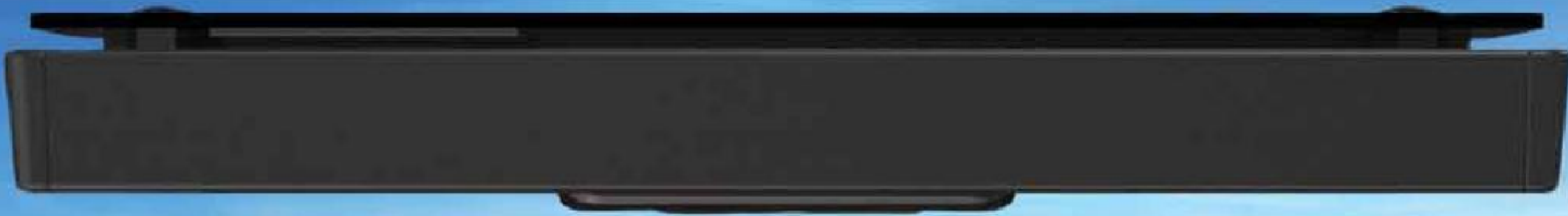
Well, as it is with any freshly set up aquarium, I was pleased to see the first new leaves of *Hygrophila* and other plants. Great, it was starting to grow!

But after a short while, the first filamentous green algae on some of the leaves proclaimed an approaching nightmare. Unfortunately, they kept expanding, but a troop of about 30 *Otocinclus* dwarf suckermouth catfishes, aided by manual removal, got this problem under control. Then I began gently fertilizing with iron and potassium, and the plants started to grow stronger and more vigorous.

Above: Small catfishes of the genus *Otocinclus* kept slow-growing plants like *Anubias barteri* var. *nana* and the Java fern *Microsorium pteropus* "Windeløv" free of algae.



With pendant LED units emphasizing certain areas, the aquarium looked as if rays of sun were penetrating the water's surface.



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The LED strips simply rest on top of the glass cover.

### Natural light effects

Back to the lighting: it is fantastic to see how the combination of strong surface movement and spotlights create light wave effects known as “glitter lines” that are reflected on the plants and substrate. The whole display appears very natural. There are, I admit, moments when I pay more attention to the ever-changing random play of light reflections than to the colors of the rainbowfishes.

Under the LED lights the plants look different and, I think, more natural. *Hygrophila corymbosa* shows pink to reddish shoots. *Limnophila sessiliflora* keeps a compact growth with short internodes, even when growing right under the strips. And the Java Fern variety “Winkelø” is a lush green. In my opinion, which has been reinforced by friends when they see the system, the overall appearance of the fishes and plants under the LED lighting is really attractive. Despite my earlier doubts about all the unknowns, I am very happy with it.

This report was written in August 2012, when the last pictures were taken. I set up the aquarium almost a year ago. I am currently regrouping the plants and replacing some of them

with more red-leaved and decorative species. A section of *Lobelia cardinalis* (“Cardinal Flower”) with its deep purple colors is planned as well. I hope to report again in these pages at a later time to document the results—with more images.

If I were making the decision today, I would use LEDs again; I like the optical impression they create better than the one created by the fluorescent tubes I have used in the past. I know there are those who favor the look of fluorescent or metal halide lights, but I can well imagine switching additional, smaller tanks to LEDs.

### Comparison

The aquarium is lit by four 22-watt strips and three 25-watt LED spots, a total of 163 watts. To sufficiently illuminate an area of 88 x 32 inches and 24 inches deep (220 x 80 x 60 cm), six or maybe even eight 24-inch (100-

Fast-growing plants such as *Ceratopteris* and *Hygrophila* developed a pleasingly compact look with sufficient fertilization.





cm) light strips would be required. Using T8 bulbs, that would be 180–240 watts, and using high-output T5 bulbs it would be 240–320 watts. If I had worked with fluorescent T8 or T5 bulbs I would have used four rows of two bulbs, eight bulbs in total. With that setup, the electrical usage would be significantly higher. Add to that the factor of lifespan: fluorescent tubes should be replaced at least every other year (some people change them out annually), while LEDs last much longer. Manufacturers are boasting of a full five years for LED emitters, but we shall see how that works out with all the aquarists now starting to try LEDs. On the other hand, LEDs cost more to begin with.

However, I don't want to do a cost-benefit calculation here; that is a matter for another report. Economy counts, but most of us want healthy, thriving plants and fishes most of all, and in my case, I am seeing it with my own eyes. 🐟

Above, left: Less light-hungry plants, such as these *Cryptocoryne affinis*, were planted in the corners and along the edges of the tank.

Right: Red-leaved water plants grew equally well—a sign of sufficiently strong illumination.

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After spawning, the female guards a mass of yellow eggs until they hatch.

## Breeding success with the Pac-Man Catfish, *Lophiosilurus alexandri*

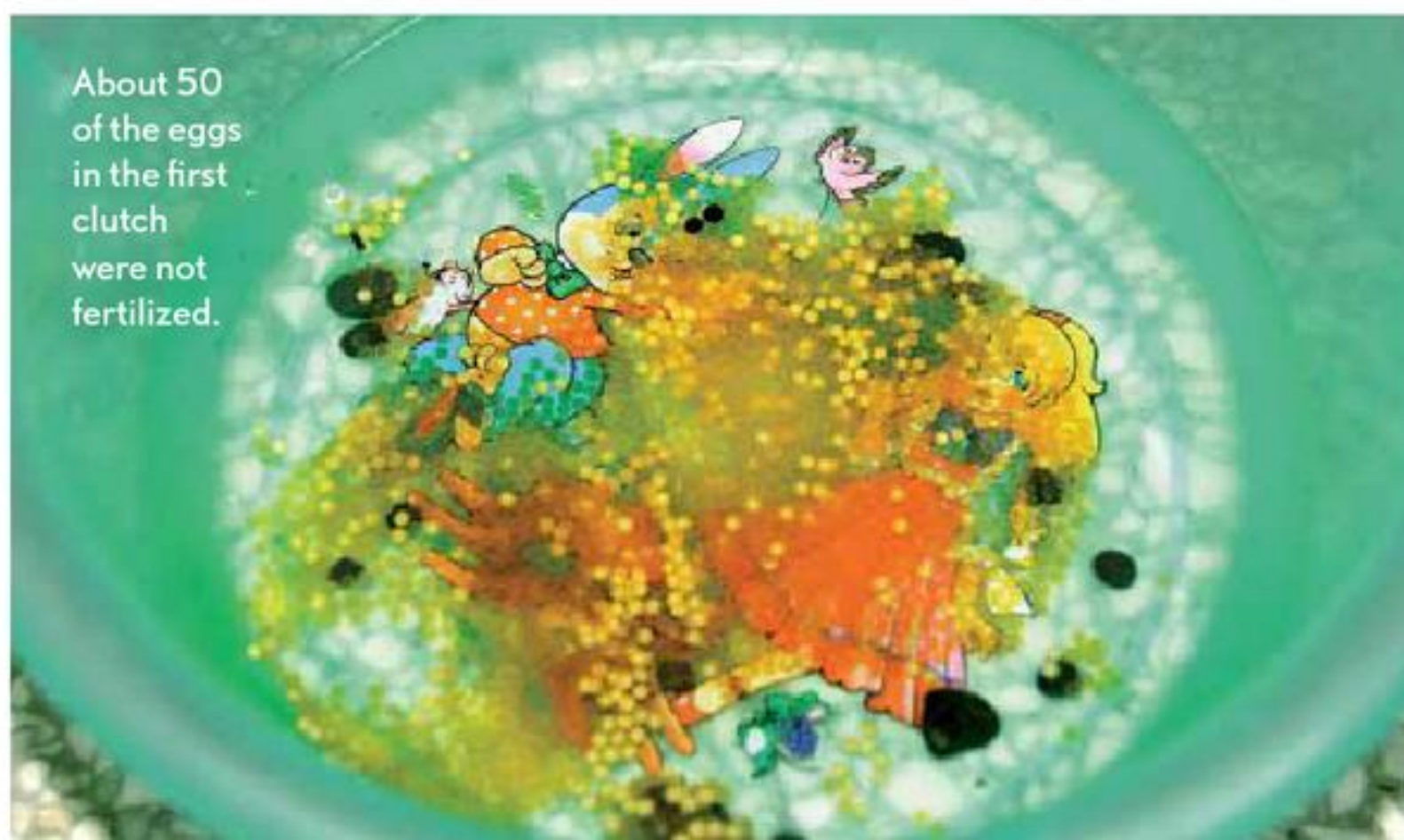
by Ivan Chang • The frogmouth catfishes of the Asian genus *Chaca* are known to many hobbyists due to their unusual body shape and behaviors. Only a few specialists know that in eastern Brazil there lives a catfish species that appears very similar but gets considerably larger. A handful of aquarists have successfully bred the Pac-Man Catfish, *Lophiosilurus alexandri*, which is capable of reaching a length of more than 28 inches (72 cm) and a weight of 11 pounds (5 kg) in the wild.



This particular catfish is very special. With its flat body, the tiny eyes on top of its head, and its huge mouth, *Lophiosilurus alexandri* is destined for aficionados of the extraordinary. The beige-colored body, with its numerous small brown spots, is usually hidden—buried in fine sand. Only the eyes and the upper rim of the mouth are visible. This ambush predator waits, buried, until a shrimp or a suitable fish swims by, then rapidly opens its large mouth to inhale the victim in one quick gulp.

*Lophiosilurus alexandri* lives in eastern Brazil in the drainage of the Rio São Francisco. Specimens have also been found much further south, in the drainage of the Rio Doce in the state of Espírito Santo. It appears that the species was released there with the intention of establishing it as a food fish—not surprisingly, given its size and a reputation for having fine-tasting flesh.

However, I was more interested in keeping these catfish in the aquarium to attempt their propagation. I eagerly studied the reports of a Japanese aquarist, who apparently was the first to succeed in spawning these animals in captivity. Delighted to find a few specimens



About 50 of the eggs in the first clutch were not fertilized.

Right: The Giant Raphael Catfish, *Megalodoras uranoscopus*, is a suitable tankmate for the Pac-Man Catfish, since it reaches over 2 feet (60–70 cm) in length as well.

that were imported to Taiwan, I purchased them and raised them for more than five years. By that time, the male had reached 25 inches (63 cm) and the somewhat smaller female was 22 inches (55 cm) in length.

### Courtship display

One day, I started to observe an interesting behavior in my Pac-Man Catfish. When the smaller female approached the male, she began to tremble, displaying with her whole body. It almost looked as if there were waves traveling along her large, soft, fleshy body. Each wave lasted between two and five seconds. These short signals prompted the male to respond in a similar manner. It was always the female who initiated this behavior, which I interpreted as a courtship display. The display lasted up to two days and afterwards I usually found eggs.

According to my observations, spawning always happened in the morning. Most pairings occurred between 7 and 8 A.M., and occasionally later, up until noon. I have never seen any reproductive activity outside of that time frame. On the evening before a spawn the fish were unusually active, and the trembling became more frequent. While they appeared to be aware of the presence of their keeper, they were not disturbed by it. The female excavated a spawning pit by shifting her body sideways in the substrate; the male circled the pit and guarded the vicinity. The female stayed in the pit to dig deeper and select a spot for the eggs. An established pit was usually selected again in later attempts. Often, the sand was removed down to the bare glass bottom, where the eggs were deposited.

### Sticky eggs

When the pit was ready, spawning followed the next morning. The female laid golden-yellow, 2-mm eggs that swelled quickly and were soon enclosed in 1-mm jelly casings. The eggs were very sticky and adhered to each other. The male carefully moved over the clutch and fertilized the eggs. During the act, his pectorals trembled in a wavy pattern. The whole spawning event took about 10–15 minutes, during which some 100 to 300 eggs were laid. Viable eggs remained yellow; unfertilized eggs turned white after two to four hours.

For the next two to three days, the female guarded



the clutch. Most of the time she lay directly on top of the eggs, but she eyed the surroundings vigilantly. The eggs' jelly-like protective casings became thinner shortly before the hatch, and finally I saw 0.2-inch (5–6-mm) larvae hatch out. The fry—relatively small compared to the adults—had black eyes, but the body and head were transparent with a huge yellow yolk sac. In the first hours after the hatch the fry were scattered around the female, but two days later they all gathered tightly and wiggled their tails. At 81°F (27°C) the larvae consumed the yolk sac within 7–10 days. They grew steadily and developed an increasingly darker pigmentation.

### Breeding Diary (2010)

**Aquarium:** 48 x 24 x 24 inches (120 x 60 x 60 cm)

**Filter:** External biofilter with supplemental aeration via a power head

**Lighting:** Dim fluorescent tube without a timer and hence irregular light cycles

**Water parameters:** pH 7.0–7.3

**Water temperature:** 81–82°F (27–28°C)

**Water changes:** One-third weekly

**Substrate:** Dark river-gravel without sharp edges, with a particle size of about 0.2 inch (4–6 mm), which was later removed for better hygiene when rearing the fry.

**Food:** Small live fish and thawed large shrimps every two to three days. (Use caution: don't overfeed! To induce spawning, increase the rations.)

**Tankmates:** Initially, another semi-adult *Lophiosilurus alexandri* and three *Megalodoras uranoscopus*. After the first signs of courtship, they were removed. At the time of the first spawning, the male was 25 inches (63 cm) total length at an age of five to six years, while the female was 22 inches (55 cm) at four or five years old.



The larvae two days after hatching. The body is still unpigmented and the yolk sac is very large.



Seven days after hatching, the yolk sac is consumed and the small catfish start to develop their pigmentation. Now they need to be fed.

**March 12:** Increasing activity between the adults, with first signs of the trembling courtship display. All the other occupants were removed, the substrate was replaced with fine sand, and one-fifth of the water was exchanged.

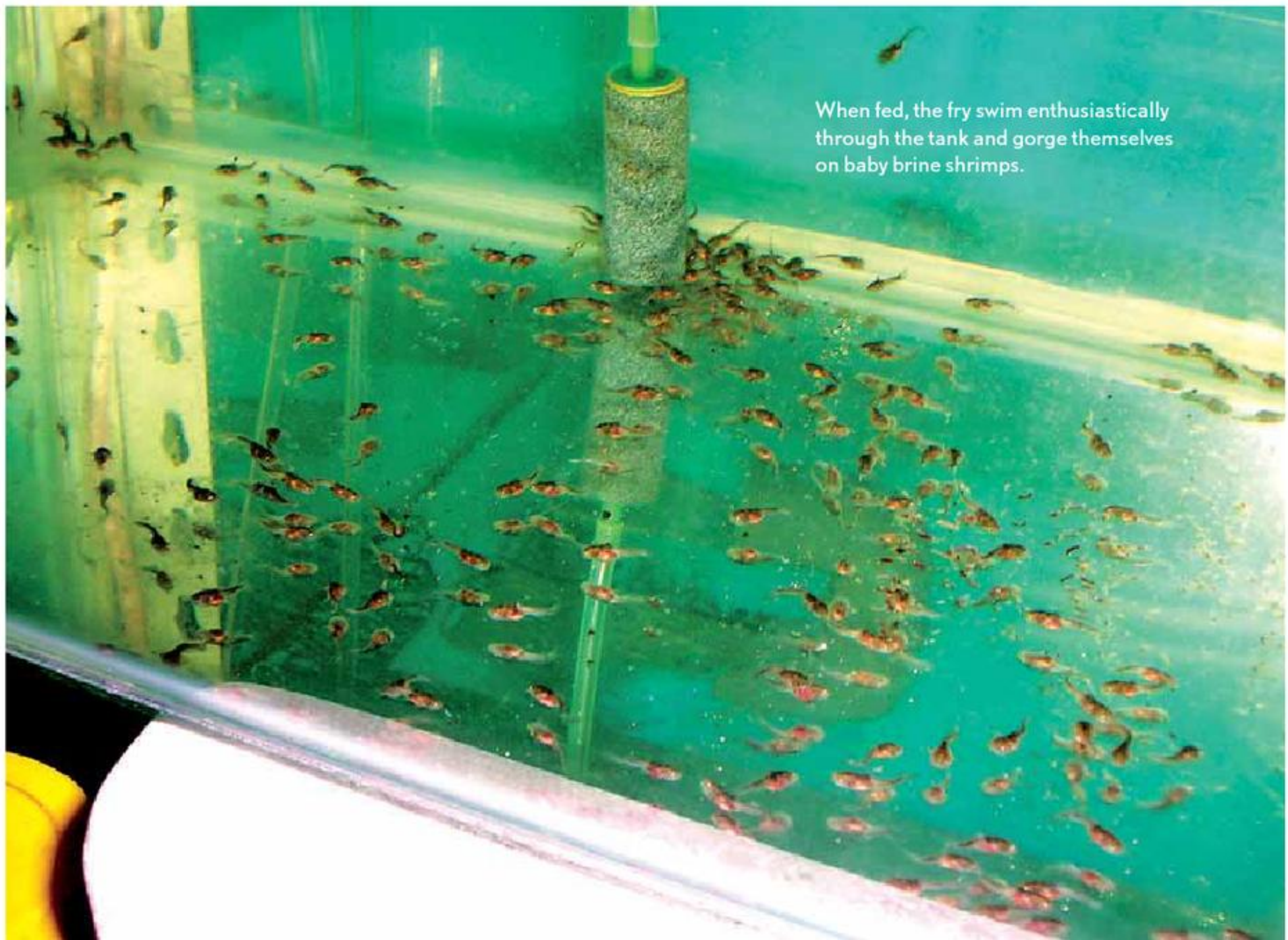
**March 15:** The female, who was usually hiding in a corner, approached the male and the two fish often lay next to each other, now actively courting.

**March 17:** The female began to mouth the sand in one spot, obviously cleaning it, while digging a pit. The male started to actively patrol the tank. The courtship became increasingly more intense when the animals met. This continued for another day, until the night of March 18, when the cleaning and courtship activities reached their peak. The male swam into the current from the filter return near the surface and slapped audibly with his fins. Meanwhile, the female dug the pit all the way down to the glass bottom.

**March 19:** Around 11 in the morning, the fish spawned. Afterwards, the female guarded about 200 eggs in the pit. The male retreated into another corner to relax. The female lay directly on the eggs and fanned them with her large fins to supply fresh water and oxygen. Some 50 eggs were not fertilized and turned white.

**March 20:** To be on the safe side, I removed the developing eggs to hatch them separately. I left subsequent clutches in the care of the parents, who cared for them quite reliably. I filled the 15-gallon (54-L) rearing tank with water from the breeding aquarium. A large airstone supplied oxygen, but I used no filter.

**March 22:** The larvae began to hatch in the morning and



When fed, the fry swim enthusiastically through the tank and gorge themselves on baby brine shrimps.



At a size of a bit over an inch (3 cm), the juveniles show a black banding pattern that later disappears. At this size, they consume copious quantities of bloodworms.

by 4 P.M. all had hatched. A total of about 120 larvae survived and were scattered all around the tank with their large yolk sacs. Because I was afraid to induce too much stress, I refrained from performing a water change.

**March 24:** A large number of fry were dead in the morning and I quickly changed some water to save the rest. Unfortunately, all the remaining fry died by the next day. I assumed that the water quality had become too poor and that I might need to lower the pH. Thus, I removed the substrate

from the breeding tank and replaced it with pH-neutral black hematite, as shown in the first picture.

**March 27:** The pair spawned again. With about 160 eggs the clutch was smaller than the first. The pH was around 7.1 at 82°F (28°C).

**March 29:** I transferred the eggs to the rearing tank, where they began to hatch within hours, resulting in about 100 hatchlings.

**March 31:** When they were about 0.25 inch (7 mm) long, the fry's pigmentation started to develop. The yolk sacs were still large but decreasing in size. I changed 10 percent of the water every other day, and in addition to the airstone, I installed a small filter. The pH was stable at 7.1.

**April 3:** Barbels and fins became noticeable. The dark fry were about 0.35 inch (9 mm) in size and began to swim about in a tight group. They reacted to light or touch with flight. I continued with 10 percent water changes daily and measured a stable pH of 6.9.

**April 5:** Seven days after hatching, the fry were 0.4 inch (10 mm) long and dark. The yolk sacs were completely absorbed. I carefully fed baby brine

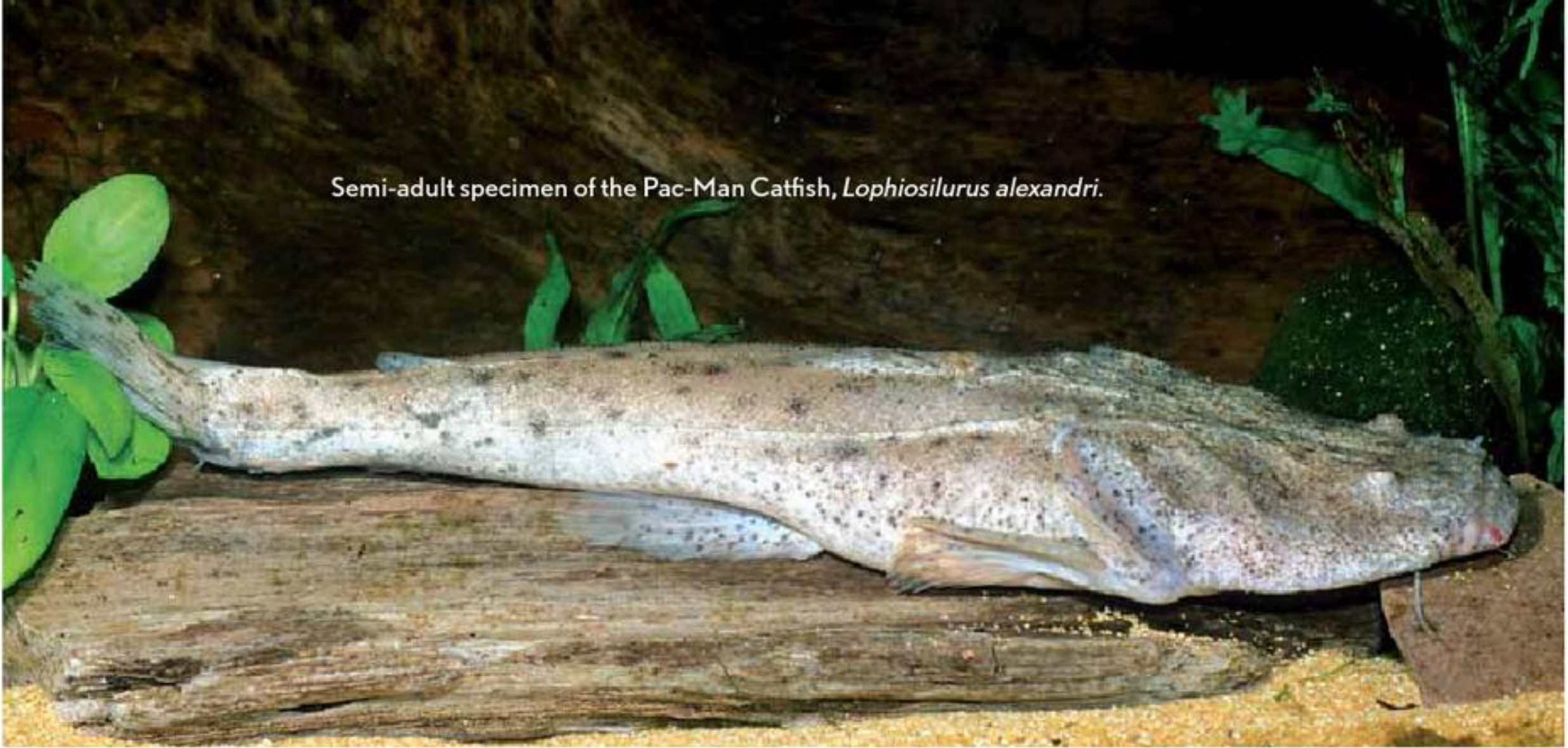
shrimps, which were greedily consumed. During daylight hours, I fed them about every four hours. A few fry refused the food and died, but the majority fed well and I began changing 50 percent of the water daily. The pH was between 6.7 and 6.9 at 82°F (28°C).

**April 7:** The babies had grown to 0.6 inch (1.5 cm) and I changed the diet to frozen bloodworms every six to eight hours. These voracious eaters polluted the water heavily,



A magnificent success!

Semi-adult specimen of the Pac-Man Catfish, *Lophiosilurus alexandri*.



so I had to change 50 percent of the tank volume two to three times a day.

**April 12:** The fry were 15 days old and looked like small Pac-Man Catfish with fully developed fins, but darker. The 64 babies were about 0.8 inch (2 cm) long. They rested in small caves close to each other, but became immediately active when food hit the water. They rapidly ate a lot during each feeding, and with daily water changes they increased their size by 0.4 inch (1 cm) per week. Within a few weeks, they had become lighter in color and turned into perfect little copies of their parents.

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To me, the captive propagation of aquarium fish is an important aspect of this wonderful hobby. With the successful breeding of the Pac-Man Catfish, a dream became reality. Intense efforts over the years, from obtaining the juveniles to having the adults spawn, eventually led to success. *Lophiosilurus alexandri* is certainly an unusual aquarium tenant and its keeping is still quite rare. I am proud to report this success. Maybe my work will inspire other aquarists to try their luck with this remarkable catfish. 🐟

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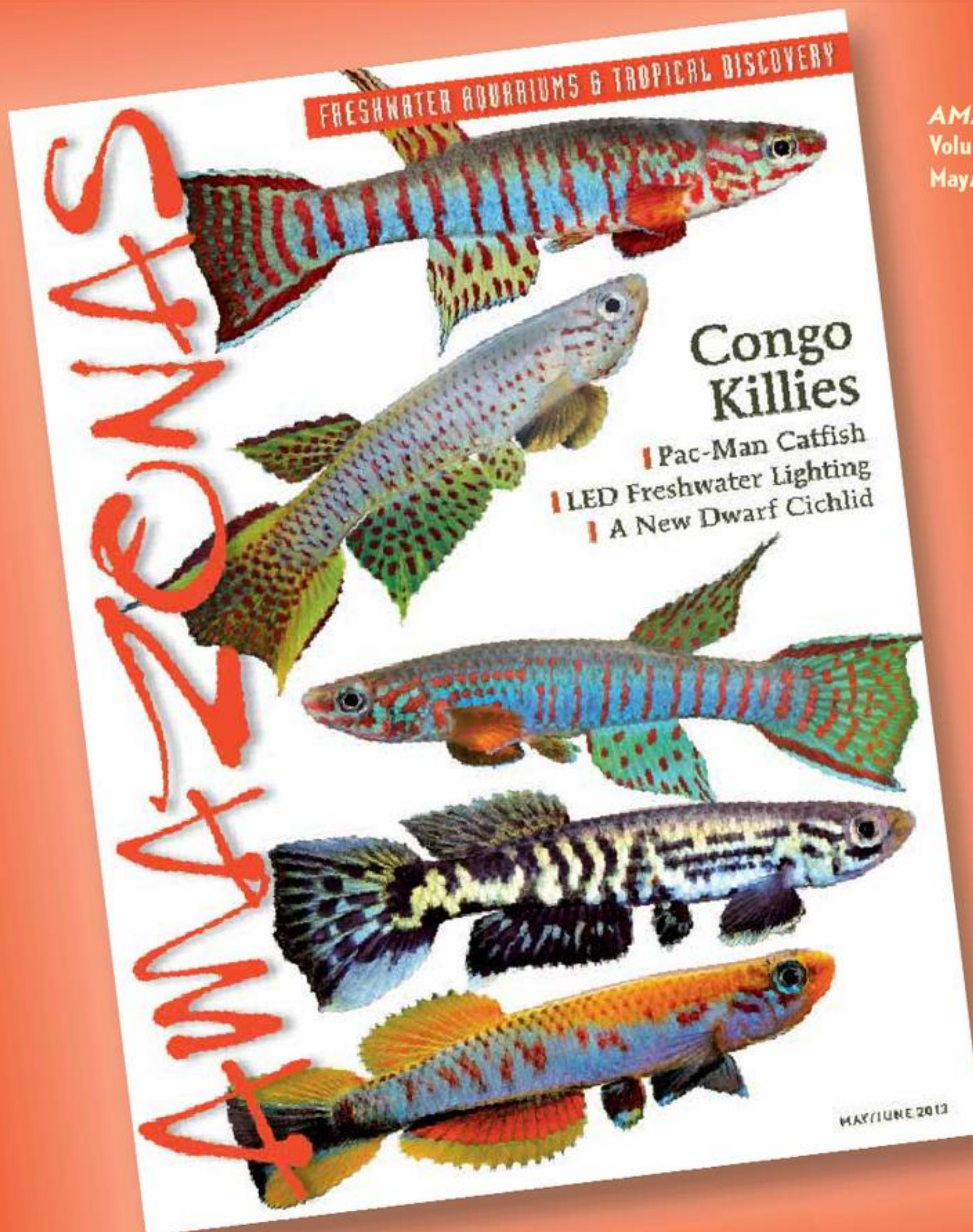
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## Using a trick to rear

# *Apistogramma playayacu*



Male Playayacu Dwarf Cichlid.



*article and images by Hans-Georg Evers* • In recent years things have been rather quiet in the dwarf cichlid arena, once so popular with aquarists. Back in the day, new species were always arriving and were enthusiastically snapped up, but now it seems that interest in newcomers is at a low ebb. In the summer of 2012 a newly described species, *Apistogramma playayacu*, found its way into my aquariums for the first time and my excitement was restored.

Martin Mortenthaler of Aquarium Rio Momon in Iquitos, Peru, frequently sends me photos of new species he has obtained. When he presented me with photos of an unknown *Apistogramma* in May 2012, I was really excited. To date, *Apistogramma playayacu* Römer et al., 2011 is known almost exclusively from preserved museum material. Kästner (2005) reported on an import going by the name of *Apistogramma* sp. “Caquetá,” but the species actually comes from the drainage of the Río Napo in the border zone between Ecuador and Peru. And that is exactly where Martin had obtained these fish.

I subsequently acquired a pair of this species at the end of June 2012 from OF-Aquaristik in Butzbach, Germany. The two fish were immediately housed in a tank of their own that was decorated with a number of caves, pieces of bogwood, and dense stands of plants. The female, who measured around 2.3 inches (6 cm) total length, was the boss of the tank right from the start and kept the male, almost twice her size, in his place.

I used reverse-osmosis water, alder cones, and black peat to establish the water parameters: a conductivity of around 200  $\mu\text{S}/\text{cm}$  and a pH of



6.0–6.5. The water temperature in the tank fluctuated between 77 and 81°F (25–27°C). The fish were fed *Artemia* nauplii and frozen food and also enjoyed frequent feeds of live water fleas and *Cyclops*. Mosquito larvae proved to be the ideal food for getting the female to ripen with eggs.

### First spawning

At the end of July the first spawning took place. The red eggs were clearly visible on the ceiling of

the cave. I hadn't noticed any courtship at all, as I had been traveling a lot and had had little time to observe the fish. The formerly dirty-gray female was now resplendent in bright yellow. In brood-care coloration the species-typical black cheek spot contrasted boldly with the bright-yellow lower half of the body. The dorsal fin and the rounded caudal fin were now yellow as well. The base of the pectoral fins was a splendid orange color in both the male and the female in brood-care coloration.

Above: Female *Apistogramma playayacu* in brood-care coloration. A fresh clutch has just been laid in the clay pipe.



The larvae continue to bear their red yolk sacs for a number of days.

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Successfully outwitted: a brooding female with fry in the rearing box.

After three days the larvae hatched and wriggled at the far end of the clay pipe, which was set at a slight angle in the substrate and open at one end. After another four days the little ones swam free and followed the female around the tank. There were only around 20 of them, and their numbers decreased each day until they had all disappeared after about a week.

For a long time, I have refrained from taking eggs or fry away from species that practice brood care in order to guarantee safe rearing with the maximum number of young. But in the case of such a rare species as the Playayacu Dwarf Cichlid, I wanted to be able to share the juveniles with a number of enthusiasts as soon as I could, so I reached into my box of tricks.

### Outwitted

With good feeding, the adults spawned again several weeks later. The evening before, I had observed the male swimming around in front of the breeding cave with the female and tentatively performing quivering movements. The devoted togetherness was over by the next morning and the female was chasing the male all around the tank, a sure sign that there were eggs attached to the ceiling of the cave once again.

This time, too, the female tended the clutch very reliably and was soon guarding a little heap of wriggling larvae with red yolk sacs. I carefully siphoned them all out with an airline and placed them in a glass rearing box suspended in the parents' tank. There were more than 120 larvae, a surprisingly large number of fry for a female of her size. Before long the mother, robbed of her brood, came closer and eyed the little ones with interest.

After two days the yolk sacs were used up and the larvae swam free. The female stayed next to the glass box and guarded the brood. The young reacted to every twitch of their mother and did all the things that they would have done if she were leading them around the aquarium. The fry were still able to follow their instincts, but the protective glass box ensured that I wouldn't lose any of the brood. 🐟

### REFERENCES

Kästner, N. 2005. Ein neuer "Zwerg" aus Kolumbien: *Apistogramma spec. „Caquetá”*. *AKZ-News*, 1/2005: 45-47.

Römer, U., J. Beninde, and I. Hahn. 2011. *Apistogramma playayacu* sp. n.: Description of a new cichlid species (Teleostei: Perciformes: Geophaginae) from the Rio Napo system, Ecuador. *Vertebrate Zoology* 63 (3): 321-33.

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## Ancistrus claro

### —a dwarf among the L-number catfishes



*article and images by Jörn Sabisch* • I had searched for *Ancistrus claro* for a long time, but sometimes things turn up right on your doorstep. That is how I was able to obtain this little bristlenose catfish from a breeder here in Berlin. Breeders are often the only source for rare *Ancistrus* species, and you must be prepared to travel long distances to get them. If you have youngsters to dispose of yourself, you quickly learn to gauge the seriousness of a potential buyer. “That’s too far for me” speaks volumes about the inquiring party’s level of interest.

The attractive vermiculate pattern in males is often mentioned in the literature, and my fishes exhibit this too. However, the females aren’t far behind the males. The intensity of the pattern can apparently be varied—these fish are very contrast-rich on dark gravel or sand. I have never seen a similar range of coloration in any other *Ancistrus*; these fish can also appear a dull gray-brown. It seems as if the vermiculate pattern can be switched on and off.

Another characteristic feature of *Ancistrus claro* is the very large mouth, almost reminiscent of *Chaetostoma* species. Other *Ancistrus* species have a more triangular head, and the difference can be seen even in very small juveniles. I keep my five *Ancistrus claro* (two males, three females) in a 20-inch (50-cm) tank with lots of clay pipes and bogwood.

*Ancistrus claro* appears to prefer a vagabond existence



Male *Ancistrus claro*.

when it comes to caves. Except at spawning time, no individual has its own cave, as my *Ancistrus* L 144 do, for example. The females drive the males out of any cave if it suits them—they are larger and more able to look after themselves. Triangular-shaped pipes are particular favorites, probably because they are a good fit for the fish's body shape. Bogwood seems to provide no particular attraction for *Ancistrus claro*. In this respect they are significantly different from other *Ancistrus* (for example, *Ancistrus* sp. "Río Paraguay", L 107).

I now feed my *Ancistrus claro* a less vegetarian diet than I use for other *Ancistrus* species—food tablets are noticeably more popular than spinach, for example. Cucumber, zucchini, and potato are more or less completely ignored. The temperature fluctuates between 73 and 79°F (23–26°C), as the heating is controlled by the same time switch as the light. A friend kept his specimens at 84°F (29°C). He said that these conditions were suggested in the original description, but now he has no fish left. It would seem that not all L-number catfishes like the conditions required by *Hypancistrus*.

After a year of maintenance, when my fish were almost two years old, I discovered the first clutch. There were fewer than 20 eggs, but they were very large, approaching 4 mm in diameter. The clutch wasn't like a bunch of grapes—the eggs were distributed next to one another in a patch on the ceiling of one of the triangular clay pipes. No egg was attached on top of the others.

The brooding male lay outside the pipe with only his head inside, continually fanning water inside with his fins. I have now observed this behavior in both males during 10 different spawnings. There was no change, even when both males were brooding clutches simultaneously and in sight of one another.

Unfortunately, I lost two clutches because, while I was away for a few days, the filter had become so clogged that the diffuser no longer created an air supply. The male apparently couldn't compensate for this and the entire clutch failed to hatch. It appears that the oxygen requirement is very high, which moved me to set the maintenance temperature permanently to around 75–77°F (24–25°C). Of course it sometimes rises to as warm as 86°F (30°C) in the height of summer, but so far all my fish species have withstood this well in the short term.

After just two days the eggs darkened considerably



Fry of *Ancistrus claro* with residual yolk sacs.



Half-grown *Ancistrus claro* still exhibits a pattern of spots on the dark body.

and became almost opaque. After four days the eyes could be seen in the eggs, but hatching didn't take place until the ninth day. From above, the freshly hatched larvae appeared banded and were very large at around .5 inch (13 mm) in length. With increasing age the young develop a white spot pattern, which may not be a match for the other white-spotted species (e.g., L 107) but still looks quite attractive.

On one point I have to agree with the literature: the young grow very, very slowly. That is also the main reason why this species is only rarely available in the trade. Sometimes you have to travel a bit further to the breeder. 🐟

.....  
REFERENCES

Seidel, I. 2008. *Back to Nature—Handbuch für L-Welse*. Ettlingen.

## CALENDAR

compiled by Mary E. Sweeney

## MAY

**2-5** **Convention**  
North American Native Fishes  
Association  
Cumberland Falls, KY  
[www.nanfa.org/convention/2013.shtml](http://www.nanfa.org/convention/2013.shtml)

**4** **Auction**  
CAFÉ, Columbus Area Fish Enthusiasts  
Columbus, OH  
[www.columbusfishclub.org](http://www.columbusfishclub.org)

**5** **Auction**  
Greater Pittsburgh Aquarium Society  
Pittsburgh, PA  
[gpasi.org](http://gpasi.org)

**10** **Glant Spring Auction**  
Brooklyn Aquarium Society  
Brooklyn, NY  
[www.basny.org/](http://www.basny.org/)

**18-19** **Show & Auction**  
IFGA Michigan Guppy Breeders  
Orchard Lake, MI  
[www.ifga.org](http://www.ifga.org)

**18-19** **Convention**  
CAOAC,  
Aquarium Club of Edmonton  
Edmonton, Alberta, Canada  
[www.caoac.ca/](http://www.caoac.ca/)

**24-26** **Show & Auction**  
Greater Chicago Cichlid Association  
Chicago, IL  
[www.gcca.net](http://www.gcca.net)

**24-27** **Convention**  
American Killifish Association  
Portland, OR  
[www.aka.org/convention/2013/](http://www.aka.org/convention/2013/)

**Contact:** [mary.sweeney@reef2rainforest.com](mailto:mary.sweeney@reef2rainforest.com)

## JUNE

**1-2** **Open House**  
Bergen Water Gardens,  
Genesee Valley Koi Club  
Rochester NY  
[www.gvpakc.org](http://www.gvpakc.org)

**20-23** **Show & Auction**  
Florida Tropical Fish Expo  
Holiday Inn, Fort Myers, FL  
[www.flafishshow.com](http://www.flafishshow.com)

**22-23** **Show & Auction**  
New England Fancy Guppy Association  
Lancaster, MA  
[www.newenglandguppies.org](http://www.newenglandguppies.org)

**28** **Auction**  
Great Lakes Cichlid Society  
Euclid, OH  
[www.greatlakescichlidsociety.net](http://www.greatlakescichlidsociety.net)

**30** **Auction**  
SCALES, Stark County  
Aqua Life Enthusiasts Society  
Massillon, OH  
[www.scalesclub.com](http://www.scalesclub.com)

## JULY

**13-14** **Show & Auction**  
Greater Akron Aquarium Society  
Akron, OH  
[www.gaas-fish.net](http://www.gaas-fish.net)

**18-19** **Convention**  
Rocky Mountain Cichlid Association  
(ACA) Denver, CO  
[www.2013aca.com](http://www.2013aca.com)

**20-21** **Show & Auction**  
Guppy Association International of  
Chicago  
Chicago, IL  
[www.guppychicago.org](http://www.guppychicago.org)

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*Acentrogobius viridipunctatus*



***Acentrogobius viridipunctatus***

**1** | The gobies and their relatives all over the world include innumerable species that would be suitable for freshwater aquariums, but attempts at their keeping have been made only sporadically, if at all. Many of these species have not been tried because they require salt water, at least periodically. In the past I, too, shared this attitude.

However, these “commuters”—and there are lots of them among the gobies and their allies—can be very easily maintained in an appropriate aquarium. Often only small amounts of sea salt (1–2 g/L) are necessary to keep these fishes in good condition. Many so-called brackish-water species even spend long phases of their lives in completely fresh water. When it comes to reproduction, and especially the first larval stages, things do become more complicated—and often saltier (Taxacher 2011a, 2011b). Another factor that is often really important with regard to the goby tribe is the availability of live food. These considerations also apply to the species discussed here, which belongs to the true gobies.

I found and collected *Acentrogobius viridipunctatus* in the administrative district of Chantaburi in southeast Thailand. They were living in a former shrimp-breeding pool in an area of Nipa Palms with a strong tidal influence, hiding among stones lying on the otherwise

muddy bottom. The salinity of the water was rather high at the time of measurement—around 10 g/L. I couldn’t resist the temptation to pack up some of these gobies and try my hand with them. They had gorgeous, iridescent metallic scales on their sides, though this isn’t reflected to full effect in the accompanying photo.

The bulldog face with the visible teeth suggests exercising caution about keeping this fish with tankmates, but so far my *Acentrogobius viridipunctatus* have been very peaceful toward tankmates and each other. Obviously these powerful fish, which measure around 3 inches (8 cm) long, require a certain amount of bottom space for their territories, but any aggression is well distributed within the group, and even in a relatively confined space there are only minor squabbles. And long periods in completely fresh water present no problems for this species either. So far there has been no breeding success—or, more accurately, there have been no attempts. *Acentrogobius viridipunctatus* can occur sympatric with the second species of the genus, *A. caninus*.

—Jens Kühne

.....  
REFERENCES

Taxacher, M. 2011a. Grundeln der Gattung *Mugilogobius*. *AMAZONAS* 7 (4), 36: 32–39.  
Taxacher, M. 2011b. Kleine Süß- und Brackwassergrundeln aus der Familie der Gobiidae. *AMAZONAS* 7 (4), 36: 14–21.



Pair of *Nomorhamphus rex*, Vermillion Halfbeak

### *Nomorhamphus rex*

**2** | The halfbeak *Nomorhamphus rex* from central Sulawesi, Indonesia, was described quite recently. These attractive fish have already been imported incognito a number of times and are now reappearing under the new species name.

The new species resembles the species *N. kolondalensis* and *N. ebrardtii*, also from Sulawesi, but differs in having a longer lower jaw and in the structure of the male copulatory organ, the andropodium. We now know 10 described *Nomorhamphus* species that occur endemic to Sulawesi.

*Nomorhamphus rex* Huylebrouck et al. 2012 is known only from three small river systems in the province of Sulawesi Selatan. In 2010, my friends Jeffrey Christian, Peter Debold, and Thomas Heinrichs and I were able to find these fishes in various clearwater rivers in the famous Torajaland in South Sulawesi and bring them back alive to Germany.

These not very aggressive fish are best maintained in a small group in cool (72–75°F/22–24°C), medium-hard to hard water. They will eat anything that lands on the water's surface. I place gravid females in small, densely planted aquariums with a volume of around 10 gallons (30 L) to give birth. I maintain the group in a 53-gallon (200-L) aquarium with a number of bottom-dwelling catfish (*Loricariichthys acutus*).

*Nomorhamphus rex* is not exactly easy to breed. My largest brood to date was 12 fry, but they measured 1.2 cm at birth and immediately ate small water fleas. I have often transferred putative gravid females that unfortunately became thinner again over the following days and weeks. Could

it be that the females resorbed the young into their body cavities because they were over-stressed by being moved?

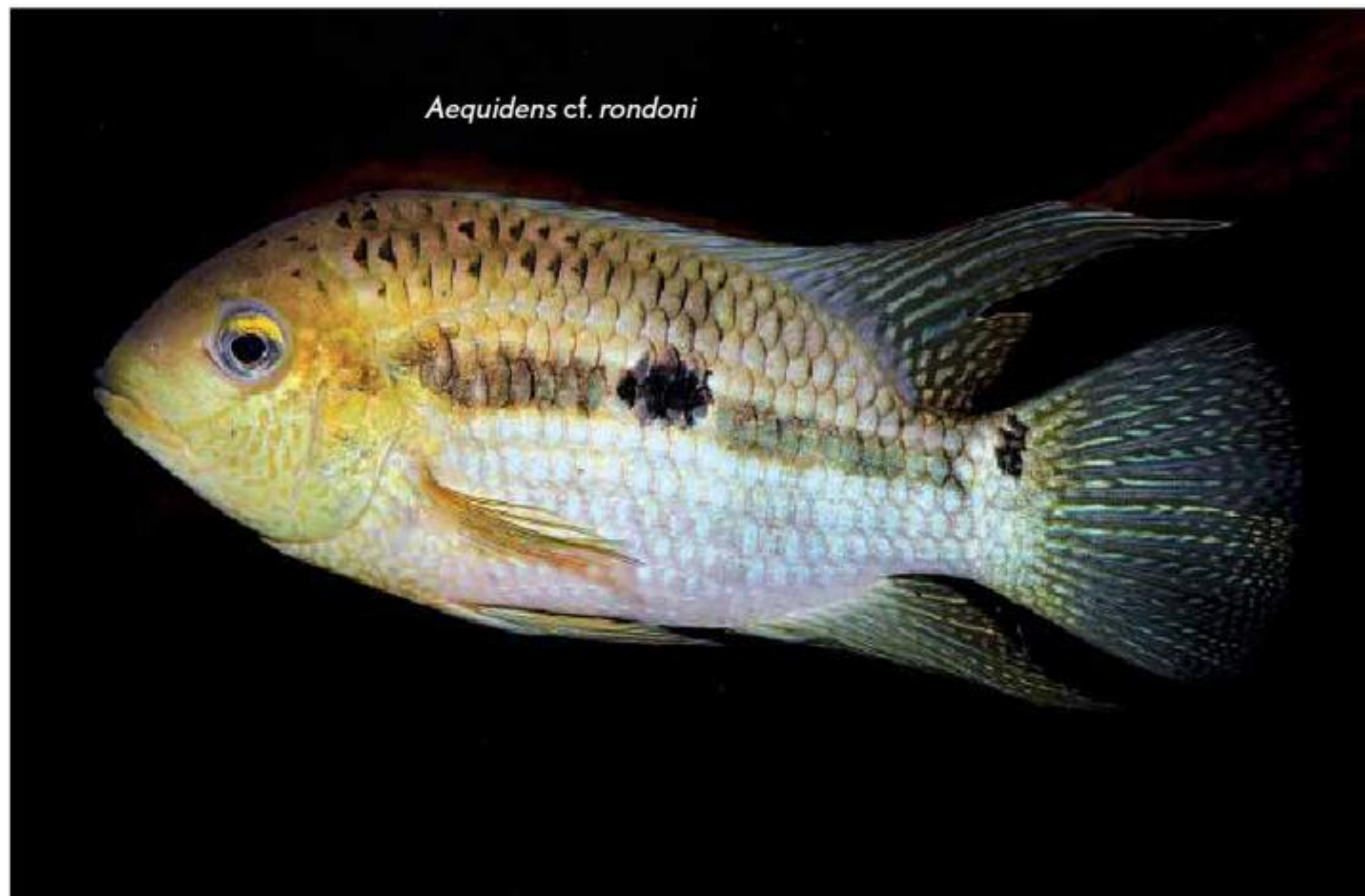
—Hans-Georg Evers

#### REFERENCES

Huylebrouck, J., R.K. Hadiaty, and F. Herder. 2012. *Nomorhamphus rex*, a new species of viviparous halfbeak (Atherinomorpha: Beloniformes: Zenarchopteridae) endemic to Sulawesi Selatan, Indonesia. *Raffles Bull Zool* 60 (2): 477–85.

### *Aequidens cf. rondoni*

**3** | *Aequidens* have a hard time of it in our aquariums. Why? Probably because half-truths stick in our heads better than the courage to question them. When I received word from Aquarium Glaser that one of their Brazilian exporters might be sending a small number of *Aequidens*, I was not that interested at first. But then I heard that they had purportedly been brought in under the trade name “Cachimbo verde,” and my interest was piqued immediately—I had seen photos of the PIPES expedition (see AMAZONAS 25) on the Web,



*Aequidens cf. rondoni*

and they included a bright green *Aequidens*. I ordered 10 individuals.

I must say, I didn't regret my decision. The new arrivals should probably be assigned to *Aequidens rondoni*, as they exhibit hints, at least, of the black-margined scales above the longitudinal band that are typical for that species. But because this isn't as strongly expressed as is usual for *A. rondoni*, to be safe I will call them *Aequidens* cf. *rondoni*.

As is apparently typical for *Aequidens* species, these fish have proved extremely easy to maintain. They greedily accept any type of food, are relatively peaceful, and are not demanding with regard to water parameters. However, even though I have kept them in soft, acid water, nothing is left of the intense green body coloration. This doesn't surprise me, since green shades are often food-dependent. At present the fish are an intense yellow, overlain with a slight greenish sheen.

One further point: the really bad guys, which are (or were) responsible for the negative reputation of the genus *Aequidens*, have now been assigned to other genera, so it is time to give these species a second chance.

—Thomas Weidner

### *Neolebias trewavasae*

**4** | The range of tetras from Africa in the trade is limited and most species are also rather drab. Hence it comes as a pleasant surprise to see such a beauty as *Neolebias trewavasae* Poll & Gosse, 1963. This little tetra from the family Distichodidae arrived in Europe in small numbers from Gabon in 2011. It grows to around 2 inches (5 cm) long, is very quiet and peaceful, and, like most South American tetras, is not very demanding.

In normal coloration, as you see them at a fish store, these fish look nice, but not that exciting; but

once settled in, they are a real sensation! The males in particular are truly gorgeous, occupying small territories which they defend against other males and into which they try to entice females. In my opinion this is absolutely the most beautiful small tetra from Africa.

The species purportedly also occurs in southern Cameroon, at least according to current wisdom. But when the fish from Cameroon are compared with those from Gabon there are noticeable differences. The fish from Cameroon are never as colorful, and the position of the lateral longitudinal band is different.

Note that some authors regard the genus *Neolebias* as a synonym of *Nannaethiops*, though I can't entirely agree. But, as is generally the case, a future revision will probably bring clarification. To put it mildly, *Neolebias trewavasae* is a stunning fish that will enrich any aquarium. With any luck, it can be bred successfully and the population increased; unfortunately, imports from Gabon are extremely rare.

—Anton Lamboj

### *Gymnothorax polyuranodon*

**5** | The attractive Black-Spotted Moray, *Gymnothorax polyuranodon*, can definitely be recommended to fans of brackish-water fishes. These fish turn up now and then in the trade, and sometimes it is possible to order them through a retailer. They won't last long in completely fresh water and should be maintained with the addition of salt right from the start.

In addition to a really tightly covered aquarium—these beasts are real experts at escaping—there should be plenty of hiding places for these sociable eels. They are predators that like to have shrimps and small fishes to eat.

They quickly become accustomed to their owner and will often take morsels of food offered using forceps—another reason, in addition to their attractive coloration,

Male *Neolebias trewavasae*,  
a scarlet-banded African tetra





Black-Spotted Moray, *Gymnothorax polyuranodon*

why these morays make good pets for aquarists and their families. Such unusual pets may even prove interesting, at least briefly, to the iPhone-addicted teenager.

—Hans-Georg Evers

### *Spinipterus* sp. "Otorongo"

**6** | The number of fans of driftwood catfishes (family Auchenipteridae) worldwide is probably negligible. The majority of members of this South American catfish family look like a bizarre piece of wood and move about as much, at least during the day. A few exceptions, such as the popular *Centromochlus perugiae*, are attractively colored. The same can be said of the species recently imported for the first time by Pier Aquatics (Wigan, England), which, on the basis of its external characteristics, should probably be assigned to the recently described genus *Spinipterus*, previously

regarded as monotypic.

*Spinipterus* sp. "Otorongo" (its trade name) was imported from Peru; no more precise locality is given. This nocturnal species appears not to grow very large. Specimens of only around 3 inches (8 cm) total length, such as the male in the accompanying photo, already exhibit clear sexual differences—for example, the copulatory organ formed from the first anal fin in males. This species practices internal fertilization. It is still not known whether the females of this species, like the similar *C. perugiae*, practice brood care, guarding eggs laid in caves.

—Hans-Georg Evers

#### REFERENCES

Akama, A., and C.J. Ferraris, Jr. 2011. *Spinipterus*, a new genus of small, spiny catfish (Siluriformes: Auchenipteridae) from the Peruvian Amazon. *Zootaxa* 2992: 52-60.



*Spinipterus* sp. "Otorongo"

## U.S. AQUARIUM SOCIETIES

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[www.cichlid.org](http://www.cichlid.org)

#### American Killifish Association

[www.aka.org](http://www.aka.org)

#### American Livebearer Association

[www.livebearers.org](http://www.livebearers.org)

#### The Angelfish Society

[www.theangelfishsociety.org](http://www.theangelfishsociety.org)

#### Aquatic Gardeners Association

[www.aquatic-gardeners.org](http://www.aquatic-gardeners.org)

#### International Betta Congress

[www.ibcbettas.org](http://www.ibcbettas.org)

#### International Fancy Guppy Association

[www.ifga.org](http://www.ifga.org)

#### Mid-Atlantic Koi Club

[www.makc.com](http://www.makc.com)

#### North American Discus Association

[www.discusnada.org](http://www.discusnada.org)

#### The North American Native Fishes Association

[www.nanfa.org](http://www.nanfa.org)

#### Northeast Council of Aquarium Societies

[www.northeastcouncil.org/nec/](http://www.northeastcouncil.org/nec/)

### ARIZONA

#### Dry Wash Aquarium Society, Phoenix

[www.DryWashAquarium.org](http://www.DryWashAquarium.org)

#### Arizona Aquatic Plant Enthusiasts (AAPE)

Tucson & Phoenix

[www.azaquaticplants.com/index.php](http://www.azaquaticplants.com/index.php)

### CALIFORNIA

#### Sacramento Aquarium Society

Sacramento

[www.SacramentoAquariumSociety.org](http://www.SacramentoAquariumSociety.org)

#### San Francisco Aquarium Society

San Francisco

[www.SFAquarium.org](http://www.SFAquarium.org)

#### Silicon Valley Aquarium Society

San Jose

[www.SiliconValleyAquariumSociety.com](http://www.SiliconValleyAquariumSociety.com)

### COLORADO

#### Colorado Aquarium Society, Arvada

[www.ColoradoAquarium.org](http://www.ColoradoAquarium.org)

#### Rocky Mountain Cichlid Association

[www.rmcichlid.org](http://www.rmcichlid.org)

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#### Greater Hartford Aquarium Society

Manchester

[www.GHASCT.org](http://www.GHASCT.org)

#### Northeast Livebearer Association

Bristol

[www.nela.northeastcouncil.org](http://www.nela.northeastcouncil.org)

#### Norwalk Aquarium Society

South Norwalk

[www.NorwalkAS.org](http://www.NorwalkAS.org)

### DISTRICT OF COLUMBIA

#### Greater Washington Aquatic Plant Association

[www.GWAPA.org](http://www.GWAPA.org)

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#### Gold Coast Aquarium Society of South Florida, Cooper City

[www.GCAquarium.org](http://www.GCAquarium.org)

#### Tampa Bay Aquarium Society, Tampa

[www.TBAS1.com](http://www.TBAS1.com)

### GEORGIA

#### Atlanta Area Aquarium Association

Atlanta

[www.AtlantaAquarium.com](http://www.AtlantaAquarium.com)

### HAWAII

#### Honolulu Aquarium Society, Honolulu

[www.HonoluluAquariumSociety.org](http://www.HonoluluAquariumSociety.org)

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#### Central Illinois Tropical Aquarium Club (CITAC)

Bloomington

[www.citac-il.org](http://www.citac-il.org)

#### Federation of American Aquarium Societies

Champaign

[www.FAAS.info](http://www.FAAS.info)

#### Greater Chicago Cichlid Association

Brookfield

[www.GCCA.net](http://www.GCCA.net)

#### Green Water Aquarist Society, Alsip

[www.GWASOC.org](http://www.GWASOC.org)

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#### Circle City Aquarium Club

Indianapolis

[www.CircleCityAqClub.org](http://www.CircleCityAqClub.org)

#### Michiana Aquarium Society, South Bend

[www.MichianaAquariumSociety.org](http://www.MichianaAquariumSociety.org)

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### LOUISIANA

#### Southeast Louisiana Aquarium Society

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[www.CapitalCichlids.org](http://www.CapitalCichlids.org)

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#### Boston Aquarium Society, Boston

[www.BostonAquariumSociety.org](http://www.BostonAquariumSociety.org)

#### Pioneer Valley Aquarium Society

Chicopee

[www.PVAS.net](http://www.PVAS.net)

#### Worcester Aquarium Society, Worcester

[www.WorcesterAquarium.org](http://www.WorcesterAquarium.org)

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#### New Hampshire Aquarium Society

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#### Jersey Shore Aquarium Society

Freehold

[www.JerseyShoreAS.org](http://www.JerseyShoreAS.org)

#### North Jersey Aquarium Society, Nutley

[www.NJAS.net](http://www.NJAS.net)

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Olean

[www.orgsites.com/ny/ARVAS](http://www.orgsites.com/ny/ARVAS)

#### Brooklyn Aquarium Society, Brooklyn

[www.BASNY.org](http://www.BASNY.org)

#### Danbury Area Aquarium Society (DAAS)

Carmel

[www.northeastcouncil.org/daas](http://www.northeastcouncil.org/daas)

#### Central New York Aquarium Society

Syracuse

[www.CNYAS.org](http://www.CNYAS.org)

#### Genesee Valley Koi & Pond Club

Rochester

[www.ggw.org/GVPAKE](http://www.ggw.org/GVPAKE)

#### Greater City Aquarium Society, Flushing

[www.GreaterCity.org](http://www.GreaterCity.org)

#### Long Island Aquarium Society

Stony Brook

[www.LIASOnline.org](http://www.LIASOnline.org)

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

### **Nassau County Aquarium Society**

Rockville Center  
www.NCASweb.org

### **Niagara Frontier Koi & Pond Club**

North Tonawanda  
www.NFKPC.org

### **Tropical Fish Club of Erie County**

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

### **NORTH CAROLINA**

#### **Raleigh Aquarium Society, Raleigh**

www.RaleighAquariumSociety.org

### **OHIO**

#### **Cleveland Aquarium Society, Cleveland**

www.ClevelandAquariumSociety.org

#### **Columbus Area Fish Enthusiasts**

Plain City  
www.ColumbusFishClub.org

#### **Greater Akron Aquarium Society, Akron**

www.GAAS-FISH.net

#### **Great Lakes Cichlid Society, Euclid**

www.GreatLakesCichlidSociety.net

#### **Medina County Aquarium Society**

Medina  
www.geocities.com/MCASfish/index

#### **Ohio Cichlid Association, Brunswick**

www.OhioCichlid.com

#### **Stark County Aqua Life Enthusiasts Society, Canton**

www.ClubScales.com

#### **Youngstown Area Tropical Fish Society**

Youngstown  
www.YATFS.com

### **OREGON**

#### **Greater Portland Aquarium Society**

Clackamas  
www.GPAS.org

### **PENNSYLVANIA**

#### **Aquarium Club of Lancaster County**

Lancaster  
www.ACLCPA.org

#### **Bucks County Aquarium Society**

Chalfont  
www.BCASOnline.com

#### **Greater Pittsburgh Aquarium Society**

Pittsburgh  
www.GPASI.org

### **TEXAS**

#### **Houston Aquarium Society, Houston**

www.HoustonAquariumSociety.org

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#### **Potomac Valley Aquarium Society, Fairfax**

www.PVAS.com

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www.MilwaukeeAquariumSociety.com

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#### **New South Wales Cichlid Society**

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www.NSWCS.org.au

#### **Victorian Cichlid Society Inc.**

Mitcham, VIC  
home.vicnet.net.au/~cichlid

#### **Queensland Cichlid Group Inc.**

Clayfield, QLD  
www.qcichlid.org

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#### **Belgian Cichlid Association**

www.cichlidae.be

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#### **Bermuda Fry-Angle Aquarium Society**

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Canada & New York State  
www.caoac.ca

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www.londonaquariasociety.com

#### **Saskatoon Aquarium Society**

Saskatoon, SK  
www.SaskatoonAquarium.com

#### **Montreal Aquarium Society, Montreal, QC**

www.theMontrealAquariumSociety.com

#### **Hamilton & District Aquarium Society**

Hamilton, ON  
www.HDAS.ca

#### **Durham Region Aquarium Society**

Oshawa, ON  
www.DRAS.ca

#### **Regina Aquarium Society**

www.reginaaquariumsociety.ca

#### **Association Regionale des Aquariophiles de Quebec, Ste-Foy, QC**

www.ARAQ.org

#### **Aquarium Society of Winnipeg**

Winnipeg, MB  
www.ASW.ca

### **FINLAND**

#### **Ciklidistit r.y. (Finnish Cichlid Association), Vantaa**

www.aquahoito.info/cichlids/index.html

### **FRANCE**

#### **Association France Cichlid, Hoenheim**

www.FranceCichlid.com

### **GERMANY**

#### **Deutsche Cichliden-Gesellschaft**

(German Cichlid Society)  
Frankfurt am Main  
www.DCGonline.de

### **MALAYSIA**

#### **Malaysia Guppy Club**

www.myguppy.net

### **MALTA**

#### **Malta Aquarist Society**

www.maltaaquarist.com/

### **SINGAPORE**

#### **Discus Club Singapore**

www.DiscusClubSG.com

### **UNITED KINGDOM**

#### **Anabantoid Association of Great Britain**

Doncaster  
www.AAGB.org

#### **BIDKA: The British and International Discus Keepers Association**

www.BIDKA.org

#### **Bristol Aquarists' Society, Bristol**

www.bristol-aquarists.org.uk

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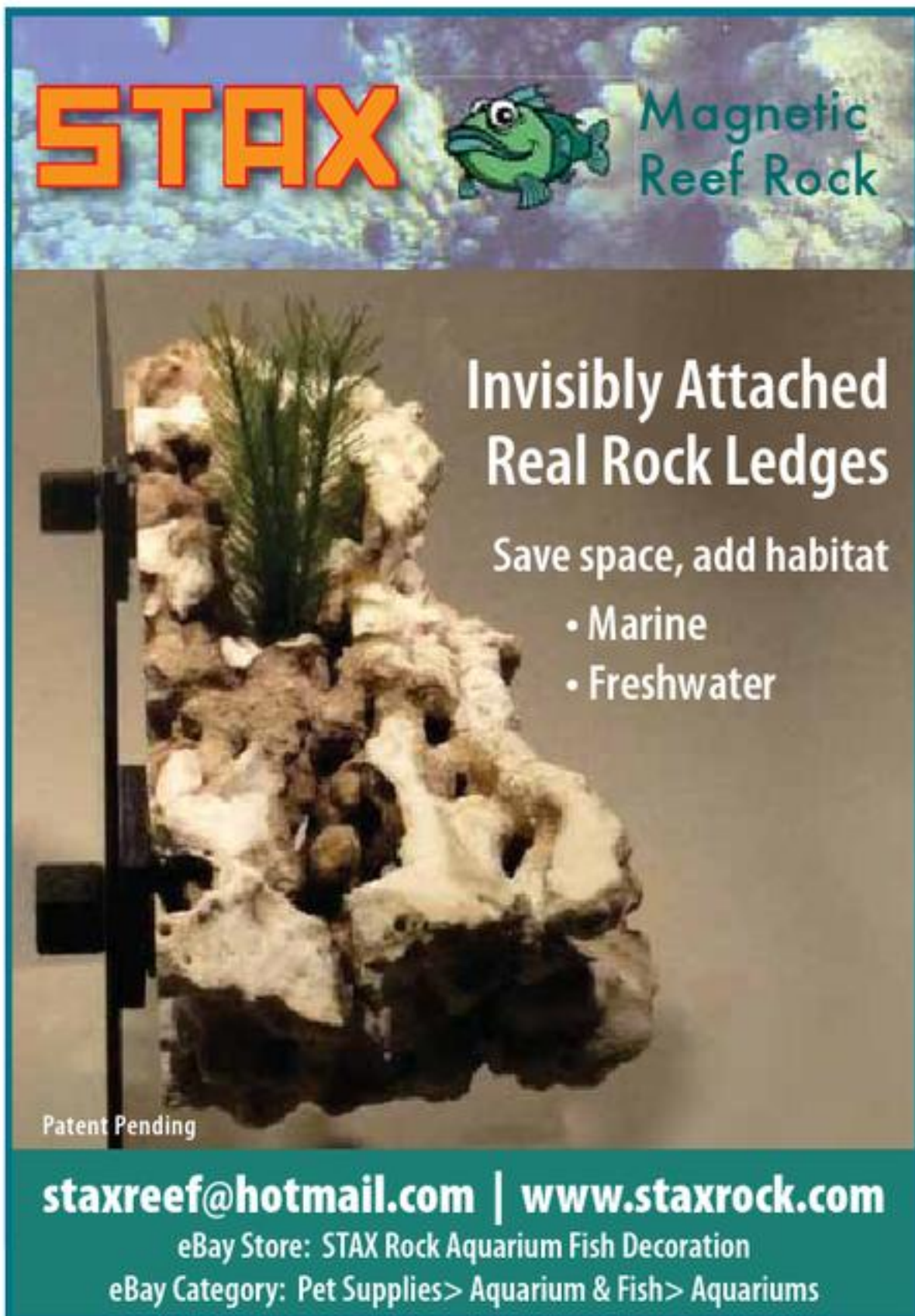
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