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☼ exotic tropical fishes supplements

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Cover:

Brycinus (formerly *Alestes*) *longipinnis*. Photo by J. Elias.

rates

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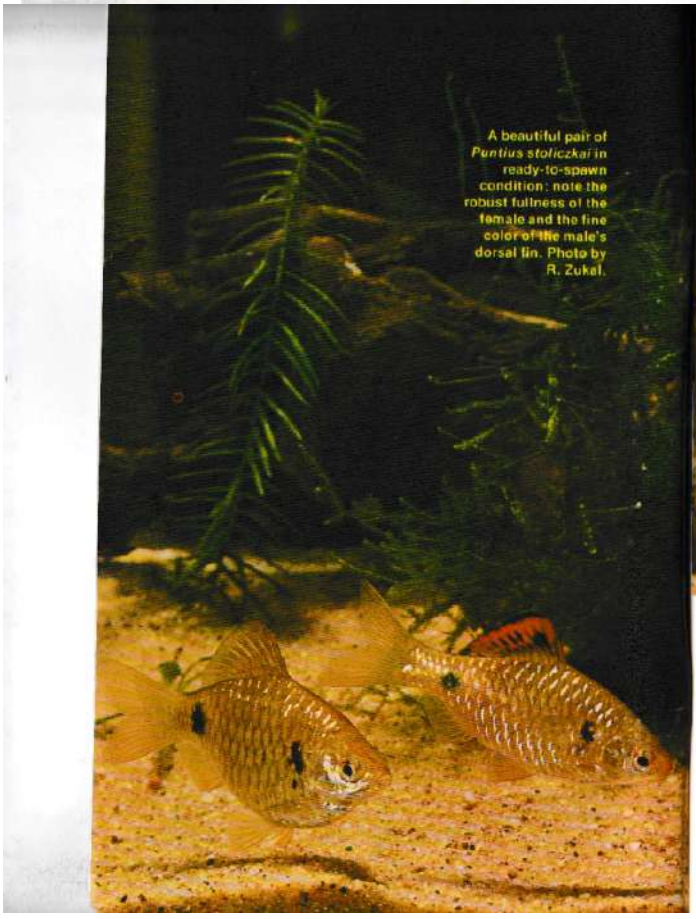
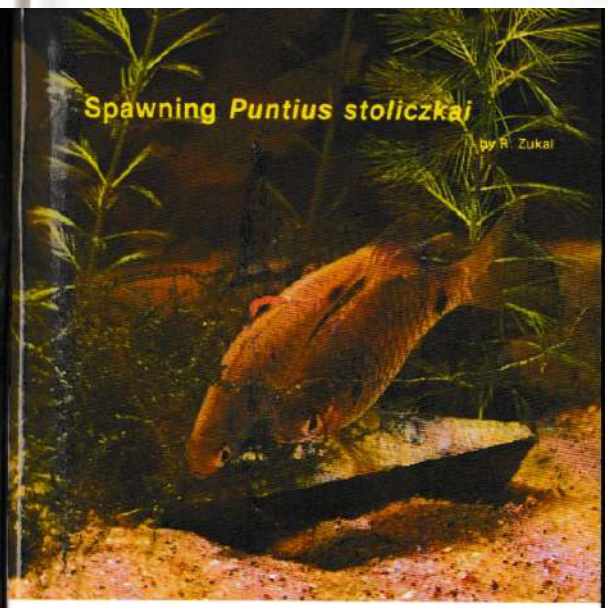


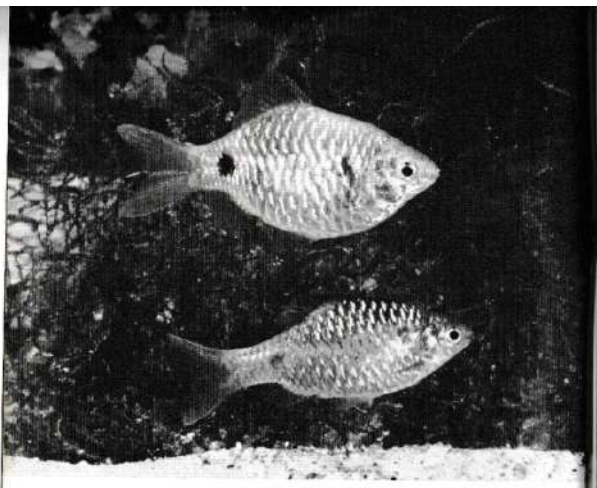
A beautiful pair of *Puntius stoliczkai* in ready-to-spawn condition: note the robust fullness of the female and the fine color of the male's dorsal fin. Photo by R. Zukal.



Spawning *Puntius stoliczkai*

by R. Zukal

A quick glance shows us that this fish is closely related to our old friend the rosy barb, *Puntius conchonius*. If the markings on the body of the male were not slightly different, one would never believe that it is not the same barb. The mouth presents no barbels, the dorsal part is olive to moss green and the belly is white. The large silvery scales are edged dark on the sides and show a bluish to yellowish sheen under inciding light. Behind the jaws, at the level of the eye, there is a drop-shaped dark spot, the rear part of which is edged with gold. On the caudal stem there is a large dark round spot, while the tail fin is yellow near its insertion. The ventral and anal fins are reddish, while the iris of the eye is either golden or else blood red. Since the female shows a solid color, the sexual differen-



The comparative fullness of the female, plus her lack of color in the dorsal, immediately separates her from the male. Photo by R. Zukal.

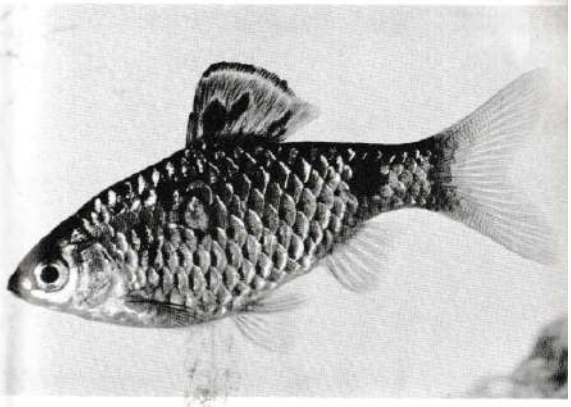
ces of adult specimens are easily recognized. The dorsal fin of the male is red in color and on the center of it one sees a sickle-shaped dark spot or a few dark dots. The red dot is ornamented with a dark edge.

This species is ideal for large tanks, as its size is reported to be up to 2 3/8 inches. Its home is Burma, from where it was shipped to Europe for the first time in 1925. Despite the fact that *Puntius stoliczkai* is prettier than *P. conchonius*, it is not found as frequently in the tanks of the hobby as the latter. The reason should be found in the fact that our species does not spawn as willingly as *Puntius conchonius*.

As to temperature, the species contents itself with 65° F. or more. The tank may be stocked with the usual plants, whenever possible with efficient illumination. Normal tap water is sufficient for the well-being of the species, which does not pose any special demands with regard to water chemistry. The bottom should be made of coarse gravel, for the fish are etern-

Many of the Asiatic barb species that have roughly the same general conformation and color pattern are very hard to distinguish as to species when they are not in full spawning color. This female barb, for example, which could easily be mistaken for a female *P. stoliczkai*, is a female *Puntius ticto*. Photo by H.J. Richter.

Settling into the thicket of *Vesicularia* at the bottom of the tank, the spawning *P. stoliczkai* complete the spawning act. Photo by R. Zukal.



The male *P. stoliczkai* at the height of his nuptial finery is resplendent in shiny scales and contrasting red and black tones. Photo by M. Chvojka.

ally hungry and pick over the bottom for food, an action which of course is accompanied by some rooting. As to feeding the species is not choosy either, taking live and dry foods indiscriminately. They should receive additional helpings of vegetable fare, as otherwise they will be nipping at the tips and tendrils of thinner plants in the community tank. If you keep a number of the fish together in a tank, it is advisable to replace part of the water from time to time, as well as to provide for extensive filtration. Communally, the fish are undemanding, peaceable and playful. Furthermore they have quite a long lifespan. I kept one specimen that lived for over five years.

Reproduction should not present any special difficulties, although, as stated above, they are not as willing to spawn as some other species of barbs. I used a five-gallon tank filled with normal drinking water and raised the temperature to 75° F. This set-up was left to age for three days. Since the species spawns among and on the plants, I placed a few strands of Java moss in the tank and planted a few other plants in the background. It goes without saying that one can also spawn

The male eagerly pursues the female through the tank, chasing her to and fro until she finally signals her acceptance by remaining stationary so that he can flutter through his spawning dance. Photo by R. Zukal.

the fish in a tank that contains only fine-feathered plants without any gravel.

The mating behavior is tempestuous and generally takes place among the plants. *Puntius stoliczkai* spawns several times per year. From spring to fall you may expect spawnings at monthly intervals. The quantity of eggs averages around two hundred. Sometimes, though, they come in larger numbers, up to five hundred, but since many eggs remain unfertilized, you may call it a success if you reap a total of two hundred fry. The fish should be removed from the tank after spawning, for they are avid egg eaters. The fry hatch after forty-eight hours. After swimming free, the brood starts taking baby foods, regardless of whether they are live or prepared. Like their parents, they are omnivorous. At the age of six weeks it is advisable to separate the young according to size.

I feel free to recommend this glorious barb to all hobbyists, if for no other reason than to prevent it from disappearing from our tanks. That would be a real pity. **t.f.h.**

Meet the Hobbyist— WALTER KOLSTO

by **Jan Carlen**
Secretary, Haugesund Aquarium Club
Photos by the author.

Haugesund is a town of about 30,000 inhabitants. It's situated on the west coast of Norway and lies be-

Walter Kolsto maintains a variety of live food cultures and keeps a constant check on their condition and productivity. The small drawers contain some of his worm cultures in different stages of development.

Walter Kolsto with part of his very extensive library of books about tropical fishes.

tween Bergen and Stavanger, Norway's new oil city. The town's economy is based on shipping and manufacturing.

The Haugesund Aquarium Club was established in February, 1972. The first year the club had approximately 20 members, but the club's popularity has steadily increased. Now it has 80 members. The membership ranges in age from 12 to over 65.

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One of the members, Walter Kolsto, has been in the club almost from the beginning. Earlier in his life he worked as a seagoing engineer, and it was during this period, when he visited public aquaria in Japan, the United States and Australia, that Walter was bitten by the "aquarium-bug." He began his hobby, as most of us do, with a community aquarium in his living room but soon found out that this was insufficient, as he wanted to get more out of his hobby. He was very much interested in breeding his fishes, so he converted a room in his cellar into a fish room. He insulated the floor and the walls and installed a thermostatically controlled oil-heater. He then bought glass, cut it himself, and glued together the 14 aquaria he now has in his room. Eight of his aquariums have a capacity of about 40 gallons; the rest are smaller, of approximately 20 gallons each.

The room temperature varies between 25° and 27° C., and the water temperature in the aquariums fluctuates between the same limits. All of his aquaria are illuminated by fluorescent tubes.

When Walter began keeping tropical fishes he started with livebearers and different kinds of barbs. Before long he had great quantities of fry. After a period with these fishes he tried his luck in breeding gouramis. You can measure his success by the fact that he bred most of the gouramis on the market in Norway.

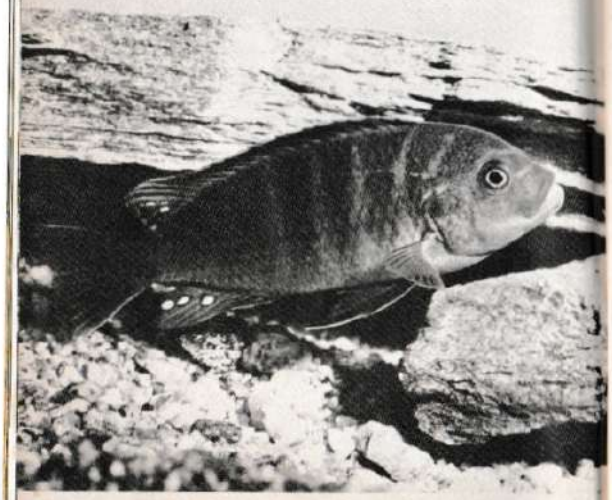
He then started a period of keeping tetras, and his greatest achievement in this group was the spawning and breeding of the Congo tetra, *Phenacogrammus interruptus*, an achievement he shares with few other aquarists in Norway or anyplace else. The tap water in Haugesund is very good for fishkeeping, having a pH value of about 6.5 and a water hardness of DH 1. When he spawned the Congo tetra he conditioned the fishes beforehand with generous feedings of live food, chiefly fruit flies and *Daphnia*.

Walter is a great believer in natural foods and he has cultures of white worms, Grindal worms and micro worms in his

Opposite:
Many of Walter Kolsto's display tanks are built into cabinets and given a framing of wall paneling that makes them look better than if they had been left bare. The paneling is hinged at different points to allow for lifting each tank's surrounding paneling so that it can be reached for servicing.

fish room. He also breeds fruit flies (*Drosophila*), and of course he regularly hatches brine shrimp as food for his fry. He rears the brine shrimp to adult size and uses them as an extra treat for fishes he wants to spawn. In the summer he gathers mussels, *Mysis* (a shrimp-like creature that lives in brackish water. It is about an inch long and is much used as a fish food by Scandinavian aquarists. It belongs to the order

The African cichlid boom hit the Scandinavian countries at roughly the same time it hit the United States and Canada, and many of the African Rift Lake fishes are established favorites there; here is one of Mr. Kolsto's male *Pseudotropheus zebra*.



Mycidacea, and its correct name is *Neomysis vulgaris*) and other snacks for his fishes at the seashore. He keeps these foods in the freezer (his spouse isn't too happy about this) and uses them in combination with the live foods.

Last year Walter's interest turned to cichlids. He has bred some of the South American cichlids, but his main interest now is the African cichlids, especially those from Lake Malawi and Lake Tanganyika. He has many different species of Malawi cichlids in his tanks and so far has spawned *Pseudotropheus zebra, Ps. tropheops* and *Melanochromis vermivorus*. In one of his tanks he has an unidentified species of *Haplochromis*, named M7. Of the Tanganyika cichlids he has spawned *Lamprologus brichardi* and *Eretmodus cyanostictus*. Walter's future plans for his fish room is to build a 250 gallon aquarium. In this tank he hopes to make a more natural environment for his Malawi cichlids. t.f.h.

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A New Approach to the Old Problem of Fish Classification: Electrophoretic Studies of *Betta*

by Ronald L. Cypher
and
Patrick C. McCarthy, Ph.D.

Phylogenetic classification of tropical fishes has often been a difficult problem for taxonomists. Some genera (*Rolofia, Epiplatys*, and *Aphyosemion* are examples) cannot be easily classifed by standard methods. Such is the case in the current controversy over the classification of *Betta splendens* and *Betta smaragdina*. *B. splendens*, of course, is the well-known Siamese fighting fish, and *B. smaragdina* is the recently discovered so-called "peaceful betta" which exhibits no fighting behavior.

Besides differing in fighting behavior, these two fishes do not freely interbreed. This suggests that they are separate species. On the other hand, they are quite similar in scale counts and fin ray counts. Furthermore, they will occasionally interbreed under certain laboratory conditions. This evidence would indicate that they are not separate species. We are attempting to solve this taxonomic puzzle by using a popular research procedure called electrophoresis.

Electrophoresis means "to separate by electricity." The procedure involves placing a tissue sample in a strip of porous material, called a support medium, through which the same can move freely (see Figure 1). Each end of the support medium is connected (by a filter paper wick) to a separate container of buffer solution that will conduct electricity. The buffer diffuses through the support medium and saturates it. A source of electricity, a power supply, is connected to each container of buffer and thereby to the support medium and the applied tissue sample. When the power supply is turned on, an

electric circuit is created, with the electric current flowing from the power supply through the support medium and back to the power supply. An important feature of this setup is that the amount of electricity, or electric charge, changes as the current passes through the support medium; in effect, one end becomes positively charged (the positive pole) and the other negatively charged (the negative pole).

Among other things, the tissue sample contains many different proteins, the all-important chemical substances that perform numerous structural and functional duties in all living things. Proteins differ from most other biochemicals in that they are electrically charged. Therefore, when electrophoresis is carried out, the proteins in a tissue sample will respond to the electric current in the system: if the electrical charge on a given protein is positive, that protein will move toward the negative pole; if a protein is negative, it will move toward the positive pole. After a certain period of time (usually a few hours) has passed, differently charged proteins will have separated from one another. For example, a protein with a strongly negative charge will be close to the positive pole, one with a moderately negative charge a little farther away, one with a weakly negative charge farther still; likewise, one with a strongly positive charge will be close to the negative pole, and so on. A neutral protein, that is, a protein with no net charge, ordinarily will not move from the point on the support medium at which the tissue sample was applied.

After electrophoresis is completed, the support medium is removed and placed in a solution that stains proteins. The finished product is a strip of support medium with transverse bands of color marking the positions of the separated stained proteins. The buffer generally used for protein electrophoresis is alkaline, a condition that causes most of the proteins to move toward the positive pole. Therefore, the protein bands in a typical separation pattern are distributed in the area between the sample application point and the positive pole.

An important advantage of electrophoresis is that the basic technique can be variously modified to examine specifically any one of many different groups of proteins. The technician can choose from many different buffer systems, support media, staining procedures, electrical settings and run times, or he can experiment with his own.

Electrophoresis is a useful tool for taxonomic classification. Any given species has many proteins that are slightly different from the corresponding proteins in other species. These differences, when examined by electrophoresis, can provide an identification of that species. It is true that there may be

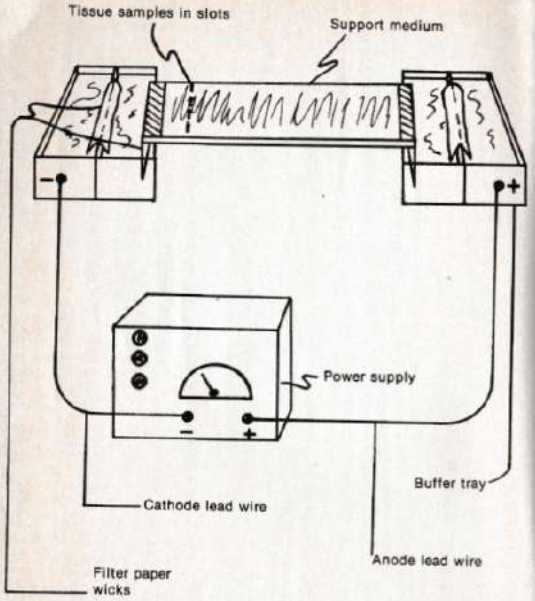


Figure 1. A typical electrophoresis set-up. Possible support media include paper, cellulose acetate, starch gel, polyacrylamide, or agarose.

many protein similarities within a genus, but some distinct differences are usually observed, even between closely related species. As a general rule, if tissue samples from different species are subjected to electrophoresis, significant differences in their protein separation patterns will be detected.

We conducted experiments using starch gel as the support medium. Starch gel resembles white Jello in texture and consistency. It is one of the most commonly used support media. We homogenized whole fishes and placed tissue samples from different fishes in separate slots in the starch gel. The buffer we used was alkaline, so the tissue proteins assumed a negative charge and migrated during electrophoresis toward the positive pole. After electrophoresis, we sliced the starch gel lengthwise and stained each half for esterase enzymes. These are proteins that have a catalytic effect on specific chemical reactions.

Figure 2 is the separation pattern of esterase enzymes from male and female *Betta splendens* and *Betta smaragdina*. Labelling is according to conventional enzyme nomenclature. There are three major banding areas in both of these fish, designated Est-3, Est-4 and Est-5. In addition, males of both species possess two faster-moving (more negative) bands, named Est-1 and Est-2. The most intensely staining band in both sexes of both fishes is Est-3. It is important to note that *B. splendens* and *B. smaragdina* differ markedly in two aspects of their esterase patterns, the migration rate of Est-3 and the staining intensity of several bands, especially Est-4. Est-3 from *B. splendens* consistently migrates faster than Est-3 from *B. smaragdina*. Est-4 from *B. splendens* stains distinctly, but it is either vague or not present in *B. smaragdina* patterns. On the other hand, Est-5 is always present in preparations from both fish, but its staining intensity varies.

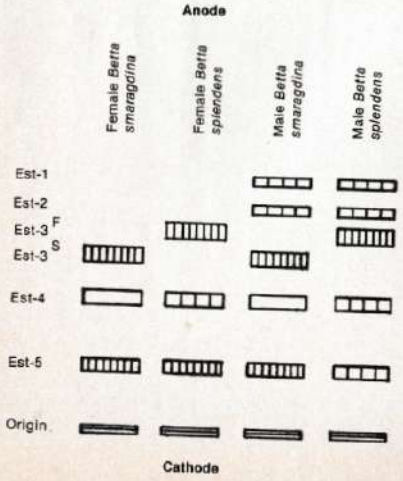
We also studied the electrophoretic patterns of general protein for these two species. Instead of starch gel, we used polyacrylamide gel as the support medium. Polyacrylamide usually produces more clearly defined protein bands than starch does. This is because polyacrylamide is composed of a more consistent porous matrix. Figure 3 is a diagrammatic summary of the general proteins of *B. splendens* and *B. smaragdina*. It is apparent that *B. splendens* and *B. smaragdina* also have distinct separation patterns of general proteins.

It should be clear to the reader that electrophoresis can

provide both qualitative and quantitative information. It can determine the types of proteins that are present in a sample and the number of each type. Additional quantitative analysis can be performed by scanning with a photodensitometer, which determines the amount of protein in each band on the support medium.

Electrophoresis cannot be used as the sole criterion for taxonomic classification. However, in the present study, electrophoretic data point toward the classification of *B. splendens* and *B. smaragdina* as distinct species. Another possibility is that *B. splendens* and *B. smaragdina* are subgroups of the same species undergoing speciation due to geographic separation. Extensive additional work must be done before either conclusion can be stated with assurance. The most telling evidence should come from comparative electrophoresis of many different protein systems.

Figure 2. Starch gel electropherograms of non-specific esterases. Shading indicates relative enzyme concentration.



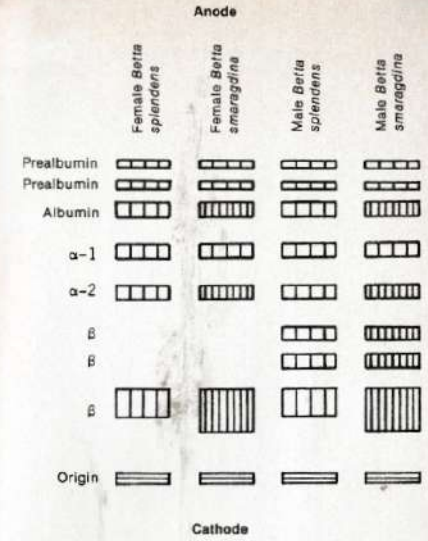
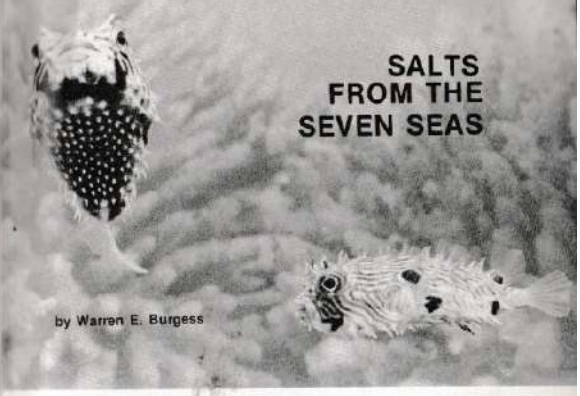


Figure 3. Polyacrylamide electropherogram of general proteins. Shading indicates relative protein concentration.

Electrophoresis is a relatively new method to be used in taxonomic work. It has been used for numerous organisms with replicable results. The technique does take some time to perfect, but good separations reveal data that make electrophoresis the most discriminating tool presently available for taxonomic research.



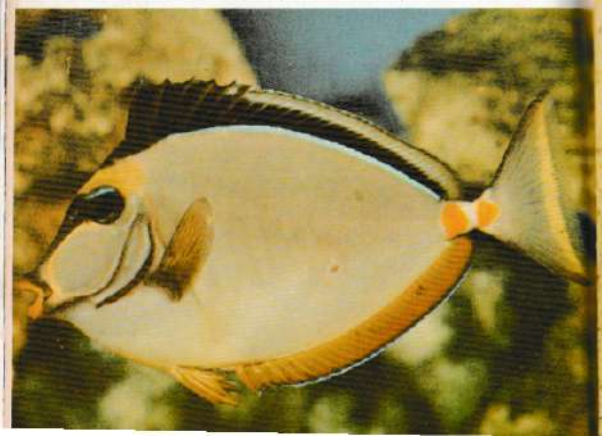
by Warren E. Burgess

When an aquarist or ichthyologist looks at familiar species, he's very likely to mentally identify the species and then pass on to other species which are less familiar. It is, however, interesting to look more closely at familiar fishes at times to see just what can be seen.

Most often when a fish's range covers a wide geographic area, like the Indo-Pacific, a specimen from the Pacific islands will be indistinguishable from, say, the East African coast or the Red Sea. But sometimes there are differences, and you may find some characteris-

Juvenile *Naso lituratus*. Even at this size the anterior black dorsal spines identify this fish as coming from the Pacific. Photo by Dr. Herbert R. Axelrod.

Naso lituratus, Pacific Ocean variety nearing adulthood. The characteristics are, however, plainly visible. Photo by K.H. Choo. Taiwan.



Naso lituratus, Indian Ocean form. This fully adult specimen has the long caudal filaments still intact. Photo by Dr. Herbert R. Axelrod. Maldive Islands, Indian Ocean.

tic which will enable you to distinguish the Pacific form from the Indian Ocean form. I have been observing fishes for some time now and in many cases am able to walk into a store and tell where the shipments come from even if there are no characteristic endemic species to tip me off. (An endemic species is one which is found in one area only—*Chaetodon larvatus*, for instance, would be endemic to the Red Sea, *Centropyge potteri* is endemic to the Hawaiian Islands, etc.). But there are other tell-tale fishes which can at least indicate whether the fish came from the Pacific Ocean or Indian Ocean. I can cite two examples of popular aquarium fishes that, by virtue of slight differences in color pattern, can be identified as far as ocean of origin is concerned.

The first of these is *Naso lituratus*. *Naso lituratus* is quite distinctly patterned in the adult stage and easily identified as such. But look a little closer at the fins, especially the dorsal and caudal fins. They can tell you where the specimen came from. One striking difference is that the anterior spines of the dorsal fin of the Pacific Ocean variety are black (the color extending a bit onto the nape in front of the fin), a continuation of the black band in the lower part of the fin; these same spines of the Indian Ocean variety are yellow, a continuation of the color band of the upper part of the fin (the color extending onto the nape and connecting with the yellow above the eye). These same colors reverse in the caudal fin: in the Pacific form there is a band of yellow a short distance inside the trailing edge; in the Indian Ocean form there is a dark brown to blackish band in the same position. There are other differences, but these are the easiest to spot.

The second species is *Balistapus undulatus*. The same thing occurs in this wide-ranging species. Take a look at the caudal area and snout area. The snout area in the Indian Ocean variety of *B. undulatus* is covered with orange spots; the snout area in the Pacific Ocean form is lined like the rest of the body. The tail fin of the Indian Ocean form is solid yellow (with a few blue

Pacific Ocean form of *Balistapus undulatus*. The characteristics can be seen in this sub-adult individual. Photo by Dr. Herbert R. Axelrod. Solomon Islands.

A younger Pacific form of *B. undulatus* with its tail fin spread, showing the tell-tale pattern. Photo by K.H. Choo. Taiwan.

Balistapus undulatus. Indian Ocean form. The spotting and yellow tail are clearly distinctive. Photo by Dr. Herbert R. Axelrod.

spots at its base) as compared to the yellow-rayed bluish form (sometimes the outer part of the membranes are yellow, especially in the central part of the fin) from the Pacific Ocean. And as far as I can tell in the specimens I have been able to see, the Pacific form has a black area surrounding the caudal peduncle spines which is absent in the Indian Ocean form.

The question always arises as to how distinct these forms are. Some research is needed to see whether other differences are present, perhaps enough even to call them separate species. If so, there are names already available in the synonymy to apply to each form.

If you find other species with such differences I would be interested in hearing from you.

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*Alestes longipinnis**

by Mrs. Daisy Berletchick

Alestes longipinnis is an African tetra that looks like the Congo tetra, *Phenacogrammus interruptus*, the fish that most hobbyists think of when they think of African tetras. Because of its good looks, size and graceful swimming motions, the Congo tetra is probably the most popular and sought-after of all African tetras, and although *Alestes longipinnis* lacks the brilliant iridescence exhibited by Congo tetras in good condition, it is nonetheless an eye-catching fish in its own right. Like the Congo tetra, it is an excellent display fish for a large tank. The basic coloration of *A. longipinnis* is silvery yellow-green, with red in the dorsal and tail fins. A wide black stripe runs through the caudal peduncle and the middle rays of the tail. The male of the species carries a beautiful flowing pointed dorsal fin.

I wanted to give the *A. longipinnis* that I obtained the best possible care, so I determined to give them the two things that my research on the species told me they should have: soft, acidic warm water and a big tank. (The big tank is needed because *A. longipinnis* is a pretty big fish by aquarium tetra standards, being far larger than the relatively very small popular South American characoids such as the neon and cardinal tetras and the commonplace *Hemigrammus* and *Hyphessobrycon* species; also, the fish needs room to display the frisky

* *This fish has been referred to most commonly in the past as* Alestes longipinnis, *but current taxonomic opinion assigns the species to the genus* Brycinus.

Brycinus chaperi (formerly *Alestes chaperi*) is very much like *Brycinus longipinnis* in the similarity of black markings along the caudal peduncle, but in *B. chaperi* the males do not have elongated filaments to the dorsal fin. Photo by R. Zukal.

swimming habits which are part of its charm.) My fish—I had only one pair, by the way—settled down nicely in the large community tank I gave them, which held water at 78° F. gradually adjusted down to a pH of 6.4 and 4 German degrees of hardness. The fish immediately gave evidence of their good health by eagerly devouring the variety of prepared aquarium foods I offered; they were not fussy eaters at all.

Although the female of the pair showed no signs of filling with eggs, I was curious to see whether my pair would spawn if taken from the community tank and given privacy. The pair therefore was placed in a bare 24-inch long tank with several clumps of artificial spawning grass on the bottom.

The spawning grass was checked each morning, but the first eggs were not noticed until they had fungused and turned white. The peculiar thing about the eggs was that they were very large for tetra eggs. An ever closer watch was kept on the tank, and soon I had some clear eggs to work with. Because

Micralestes stormsi, a seldom-seen African characoid closely related to the fishes in the *Brycinus-Bryconalestes-Phenacogrammus* genera grouping. Photo by Dr. Herbert R. Axelrod.

The upper fish is a fully developed male Congo tetra, *Phenacogrammus interruptus*; the lower fish is a fully developed male *Hemigrammopetersius caudalis*; notice the similarity between the latter fish and the male *Brycinus longipinnis* shown opposite. Photo by Dr. Herbert R. Axelrod.

A fine mature pair of *Brycinus longipinnis*, male above. Photo by J. Elias.

there was only one male to fertilize the eggs, about three-quarters of them fungused. It didn't seem possible that this slim female could carry nearly one hundred eggs of the remarkably large size I had seen. I found out later that when the eggs are expelled they are very small; they then absorb water and expand to the larger size.

The fry are easily seen beginning to develop in the egg within 24 hours. Within another 48 hours all the fry are free from the eggs. By the end of one week the fry are large for tetra fry and are free-swimming.

Only for the first two or three days do the fry need food smaller than live baby brine shrimp. After this the live shrimp proved to be the most satisfactory food for the young. This was supplemented with feedings of fine powdered fry food and finely ground vegetable flake food. *A. longipinnis* prefers to swim through the middle region of the water rather than the top or bottom levels. This made the live baby brine shrimp ideal, because the fry would not feed on any food that had settled to the bottom of the tank.

Although the young were fed four and five times a day, growth was very slow for the first four weeks. They did show the black marking in the tail area like the adults, but they were hardly larger than a newly born guppy. However, during the next month the growth rate increased and they were over an inch long after two months.

Some of the young *A. longipinnis*, six months old and easily sexable, have been returned to a community tank along with the original pair and other species of tetras and barbs, (clown barbs, rainbow tetras, black tetras), and scissor-tail rasboras. All these fish are fast swimmers, but with plenty of room there seems to be very little serious fin-nipping among them. **t.f.h.**

MOORILY WE ROLL ALONG

by Dr. Wolfgang Staeck
Photos by the author

If you take one group of fish of a single species and split them up into different areas in a big lake and then make sure that the fish in one small area can't get to the fish in a different small area to spawn, pretty soon they start to look different (assuming that the fish in each isolated group mutate in different ways). Perhaps that's what has happened in Lake Tanganyika with the basic stock of *Tropheus moorii*; this baby goes one better than different strokes for different folks and gives us different races for different places.

Many different colors are represented in the color pattern of the *T. moorii* variety called the "rainbow" *T. moorii*. Photo by Dr. Wolfgang Staeck.

In the spring of 1974, I would never have dreamt that a year later I would be getting the opportunity to carry out a thorough examination, over several weeks, of the part of Lake Tanganyika belonging to Zambia in which there is a particular wealth of different colors and races of *Tropheus moorii*. Since some of those races have already been imported and others will be imported in the very near future, I would like to provide a brief introduction of the most important ones below. With the

The red coloration of the red-black *T. moorii* depends for its intensity on the excitement level of the fish. Photo by Dr. Wolfgang Staeck.

The green-red *T. moorii* gains its greatest degree of greenish color overlay only when the fish is frightened. Photo by Dr. Wolfgang Staeck.

exception of the stripe-tailed *T. moorii*, already mentioned by Poll in 1956, these color races are completely new discoveries.

Roughly up to the age of five weeks and a size of 2½ centimeters, the fry of all southern races of *T. moorii* show the well-known pattern of eight or nine yellowish and dark brown cross-bands. "Adolescent" fish, on the other hand, are of a coloration distinctly different from that of the northern races. On a dark base they bear nine to ten very narrow whitish-yellow cross-bands not exceeding the width of a scale. One striking peculiarity of these stripes lies in the fact that they are not continuous but consist of small individual lines which, like the scales, follow a zig-zag course. Since these markings are characteristic of all southern races, it is difficult to tell, where fry are concerned, which variety the fish belong to.

The adult fish distinguish themselves above all by very colorful dorsal and anal fins, which usually are of a red or violet shade but sometimes can also be blue. Since *Tropheus moorii* is a cichlid whose coloration is greatly dependent on mood, a binding description of colors and markings presents considerable difficulties. The most colorful race has since become generally known as the rainbow *T. moorii*. Fully grown animals possess a shiny red-violet dorsal and anal fin. The region around the lips and throat looks pale blue. The cheeks and the breast are bright red in color and carry a pattern of tiny light blue or light green speckles. The dorsal region looks olive, and the abdominal region—notably in courting or fighting fish—has a white-yellow color.

Another race has been given the name green-red *T. moorii*. In a frightened individual of this variation the body looks deep green. Normally, however, only the dorsal region shows a greenish color, while the abdominal region tends to be

ACA CONVENTION/SHOW

The Everglades Aquarium Society is host club for this year's annual convention/show of the American Cichlid Association, which will be held July 30 and 31 and August 1 at the Hollywood Beach Holiday Inn Resort (4000 South Ocean Drive, Hollywood Beach, Florida). In addition to the show and auction and the regular social activities, seminars featuring such notable speakers as Jack Wattley, Homer Arment and H. Ross Brock will be held. For more information, contact Convention Chairman Neil Jerguson, 1820 Opa-Locka Blvd., Opa-Locka, Florida 33054. Telephone: (305) 681-7866.

A pattern of fine yellowish transverse stripes is characteristic of half-grown individuals of the southern race of *T. moorii*. Photo by Dr. Wolfgang Staeck.

more yellowish-green. In an excited animal the dorsal fin assumes a bright copper red.

In the black-red *T. moorii* changes in color are equally marked. In a container for despatch or in an empty aquarium the fish look red all over. At a normal amount of stimulation, however, this shade is covered by black. The dorsal fin, and occasionally the abdominal fins and the anal fin as well, show an intense red. In greatly excited fish a red band forms between the eye and the upper lip and another one between the corner of the mouth and the lower edge of the operculum. In some animals the stripe on the forehead is permanently visible.

There can be no doubt that the stripe-tailed *T. moorii* is one of the most splendid variations of the species. Adult fish bear a cherry-red longitudinal stripe on the caudal peduncle, which can extend from the caudal fin roughly to as far as the anterior end of the anal fin, though it is fairly variable in its

A half-grown lemon *T. moorii* photographed shortly after capture in a photo tank. This specimen shows only the transverse stripes, and the dorsal fin does not show the bright red-violet color. Photo by Dr. Wolfgang Staeck.

The stripe-tailed *T. moorii* is considered by some to be among the most beautiful of all color variations in the species; the fish shown here has an unusually large spot of color on the caudal peduncle. Photo by Dr. Wolfgang Staeck.

width. The hard region of the dorsal fin and the anal fin also shows this intense red. In the majority of fish the abdominal fins and pectoral region also are red. In a greatly excited fish the iris, too, assumes this color. The region around the lips looks bluish. The rest of the body is brownish or jet black in color.

The latest discovery is the lemon *T. moorii*. In adults the basic color is pale green to blackish, and a bright lemon-yellow spot, fairly variable in size, can be seen on the flanks. In some cases it is no bigger than a medium-sized coin, whereas in others it covers the entire lower half of the body. In excited fish the iris looks pale blue. Here again the fish appear to be divided into two distinct breeds. In one the dorsal and anal fins are of an intense reddish-violet color; in the other they are bluish-grey.

The multiple occurrence of *T. moorii* of different coloration in a comparatively small area is explained by the fact that the southern end of Lake Tanganyika is heavily divided by bays, fjords, and peninsulas and therefore possesses an uncommonly extensive coastal zone. Despite the sometimes baffling differences in coloration, the fish described above do not belong to different species but are merely geographical races or subspecies of the species *Tropheus moorii*. There are no transitional forms between the individual races. Rather, their distribution extends over clearly defined but greatly variable in size areas. Some races inhabit a coastal strip with a length of about 40 kilometers, others an area that measures no more than half a dozen kilometers.

The extensive sandy shores or estuaries can be considered to be the geographical barriers that prevent the mixing and interbreeding of neighboring races. *Tropheus moorii* is highly specialized as regards nutrition and avoids sandy regions, since they offer it neither food nor the possibility to reproduce. The estuaries of large rivers are avoided because they tend to be boggy and the water in them, as compared to that of the actual lake, is of a loamy cloudiness and an entirely different composition.

When breeding these fish it is very important to preserve the purity of the different races—crossing must be avoided at all cost. Hybridization would lead to mixing of the differences in color and result in mixed variations that would give little satisfaction.

MAIL CALL

If you have an aquarium question that you would like to have answered, send it to MAIL CALL. Letters containing questions of course cannot be acknowledged or answered personally, but each month a number of the most interesting questions and their answers will be published in this column. Address all questions to: MAIL CALL, T.F.H. Publications, Inc., P.O. Box 27, Neptune City, New Jersey 07753. Please do not combine MAIL CALL questions with correspondence about subscriptions or book orders.

No PDQ on PVC

Q. I am looking for PVC pipe designed specially for aquarium air use and have not been able to find it. It is the same type as used in many pet shops I have seen to supply air to their tanks. There are types of PVC pipe that you can buy from hardware, building supply and general merchandise stores, but if you are going to use this type you have to drill holes in it before you can screw pipe valves into it. I am looking for the same type that is in use in pet shops, the kind that you don't have to drill into.

Eddie Gamble
St. Louis, Missouri

A. *We don't know of anyone who sells PVC pipe with holes pre-drilled for insertion of aquarium air valves, and we think that shops that use it to channel air from their pump(s) to their tanks get undrilled pipe and drill it out themselves. But if drilled pipe is definitely available in your area, why not just ask one of the dealers who has it where he got it?*

Effects of Water-Changing

Q. I have a 20-gallon tank holding two pairs of kribensis. They have laid eggs, and the eggs are almost ready to hatch. Would the weekly change of one-fifth of the water make the parents eat the eggs? Also, would it harm the fry in any way?

Larry Gormley
Nashua, New Hampshire

A. *No, it wouldn't make the parents eat the eggs, and it wouldn't harm the fry. It would do both parents and fry a lot of good. During the time the fry are growing up, they would be especially benefited by frequent partial water changes.*

Unknown Native

Q. Recently, I was collecting food fish from a nearby river when I noticed a small goby-like fish resting on the bottom near the bank. After several minutes, others were observed emerging from crevices. Five males and one female were captured and placed in a 30-gallon community tank. The temperature and water conditions were similar to the river, 75° F., a pH of 8, and 15.5 German degrees hardness. The fish remained on the bottom, used their pectoral and pelvic fins for supports, and exhibited a gregarious nature. They accept frozen brine shrimp and chopped meal worms along with commercial preparations. I do not believe these fish are native and would appreciate any information as to food requirements or breeding habits that you could provide.

Here is a more detailed description to aid in their identification:

1. Captured specimens ranged in size from 1.25" to 2.75" in length.
2. Has fully split dorsal fin with 10 rays in each; first dorsal has horizontal bar of turquoise at the top followed by a clear bar and then an orange one. The second dorsal has a vertical bar of orange down each ray.
3. Pelvic fins have an orange leading edge; remainder is turquoise.
4. Anal fin is turquoise.
5. The eye has a black vertical bar through the middle.
6. The lower half of the head to the pectoral fin is turquoise.
7. The body has alternate vertical black stripes and orange spots, the number varying with length.
8. The fish has the ability to move its head approximately 150° from side to side. When eating, it will watch its prey and suddenly lunge.
9. Female lacks all fin coloration and is smaller in size.

Ronald W. Schmidt
New Braunfels, Texas

A. *Your description fits the greenthroat darter,* Etheostoma lepidum, *found from Oklahoma to central Texas. Several other darters occur in Texas rivers, all with about the same requirements: clean, hard, heavily oxygenated water at a temperature under 75° F. (65-70° F. best). They can survive at higher (to 85° F.) temperatures but become listless and often get fungus. They like heavily vegetated areas. They usually feed on the bottom, though they'll take live food from the surface. They can "run" up the corners of the aquarium, so it must be securely covered; rock piles help reduce this. They will eat flake foods, but small brine shrimp, glass worms, mosquito larvae, and possibly occasional* Tubifex *worms are much better. Darters will spawn in the aquarium if all conditions are correct, laying eggs on the plants. The fry need very fine food and usually do not metamorphose in the aquarium.*

Nosy Swordtails

Q. Could you give me a good explanation for why my new brick red swordtails (*Xiphophorus helleri*) have started to swim up and down the glass in the aquarium? I have not been able to figure out why it is happening.

John Pryor
New Canaan, Connecticut

Black wag swordtails. Photo by New York Zoological Society.

A. *Probably they are either just examining their new surroundings or are looking for something to eat on the glass. New fishes in a tank usually do some exploring of their quarters.*

ters after an initial period of shyness and strangeness has worn off. Some, in fact, don't have any shyness to overcome and start in their exploratory ramblings immediately upon introduction.

Baron Moenkhausias?

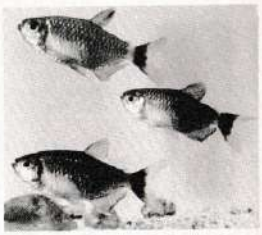
Q.1. I recently bought a pair of *Moenkhausia* tetras, and I can't find any information on them. Could you tell me something about them? I also want to know the scientific name for them.

2. I have a 10-gallon tank, and I was told that I have too many fish in it. Here is a list of the fish in the tank; are there really too many?

- 2 small angelfish
- 5 small zebra danios
- 2 Chinese algae eaters (small and medium)
- 3 medium-size neon tetras
- 3 small cardinal tetras
- 1 black-spotted *Corydoras*
- 2 medium-size longfin black tetras
- 3 small rasboras
- 2 black neons (small)
- 2 Moenkhausia tetras (small)

Tom Graul
Lincoln, Nebraska

Moenkhausia pittieri. Photo by M. Chvojka.



Moenkhausia oligolepis. Photo by G. Senfft.

Moenkhausia colletti. Photo by Dr. Herbert R. Axelrod.

A.1. *There are three or four Moenkhausia species available from time to time, so we don't know which species you have and therefore can't tell you anything about your specific type. The three species most commonly encountered are* Moenkhausia pittieri, Moenkhausia oligolepis *and* Moenkhausia sanctae-filomenae. *All are lively, hardy fishes that take the same requirements as and behave roughly the same way as tetras of the genus* Hemigrammus *and* Hyphessobrycon, *although they*

Moenkhausia dichroura. Photo by M. Chvojka.

are a little nippier than most of the fishes of the two genera named.

2. *Yes, you have too many. Under optimal conditions you could get away with keeping the number and variety of fishes you have in your 10-gallon tank, but you don't yet know enough about providing optimal conditions and therefore are looking for trouble. You'd be better off by eliminating the zebra danios and the small angels.*

In the Cooler

Q. In the Mail Call column in your May issue, a hobbyist inquired about an aquarium cooling system. I have been planning to fix up a cooling system for a goldfish tank. I won't be able to do it for some time yet, however, so I thought I'd pass on my idea so that other readers could perhaps take advantage of it and do some experimenting.

My idea is to put a metal coil in the freezer part of my refrigerator and pump the air into my tank through that coil. A person trying to use a setup like this would have to experiment to see the size of coil needed and also the size of the pump that would be needed to pump the air through the coil; a compressor might be necessary. To put the tubes to and from the coil, you'd have to be very careful in putting any holes in the refrigerator liner. Maybe the tubes could be run out through where the door is by cutting away a small piece of the rubber seal on the door. Some refrigerators and freezers have brackets that are bolted to the liner for shelves. If one or two of these brackets were removed, there would be a hole for running a tube through. The tube from the refrigerator or freezer to the tank could be insulated by wrapping newspaper around it and taping the newspaper (newspaper is one of the best insulators). For safety, one could leave a heater hooked up in the tank; if the water becomes too cool, the heater would go on.

Donald Mahanay
Benson, Arizona

A. *We don't know all the ramifications of drilling holes in refrigerator liners and running tubes through them, so we can't pass on the advisability of your idea; it seems to have merit, but it would no doubt be best to check on how the setup would affect the efficiency of the refrigerator or freezer so treated before hooking up the apparatus. You could achieve somewhat the same effect with possibly less trouble and expense (although with a good deal more work involved in the day-to-day maintenance of the setup) by filling a picnic chest or other insulated container full of ice and running the airline through the cold chest.*

In any event, thank you for passing along your suggestion to help other hobbyists.

White Worms

Q. I have read that white worms are a good live food for many tropical fish and are easily raised. Could you please tell me where I can get some white worms and how to raise them so that I can use them as live food?

Laurence L. Hsu
Seattle, Washington

A. *Yes, white worms are a good live food and are taken by many fish, and they are not overly difficult to raise. Some pet shops sell starting cultures, and a number of firms (including advertisers in this magazine) offer starting cultures by mail. In most cases the individual or firm who sells the starting cultures also offers instructions on raising the food, but in any event here is an excerpt from the excellent* Encyclopedia of Live Foods, *by Charles O. Masters, that should be of help to you.*

"White worms are generally believed to be one of the most practical of year around live foods for aquarium fishes. They are easily propagated and multiply quickly, even if only slight attention is given to the culturing process. When cultures are started early enough in the fall, they usually can keep up with live food demands when the weather stops the availability of other live foods. It is only fair to mention, however, that some aquarists insist that the worms cause constipation among tropicals and should be fed sparingly, including them only as part of a well rounded diet. It is also recommended by some aquarists that one should purge the worms in a container of cool water for about twenty minutes before feeding to tropicals.

"The egg capsules, too, make excellent food for baby fishes. In a well managed culture, the surface of the soil is almost encrusted with the little translucent white globules which can be removed or skimmed off with a pointed knife blade.

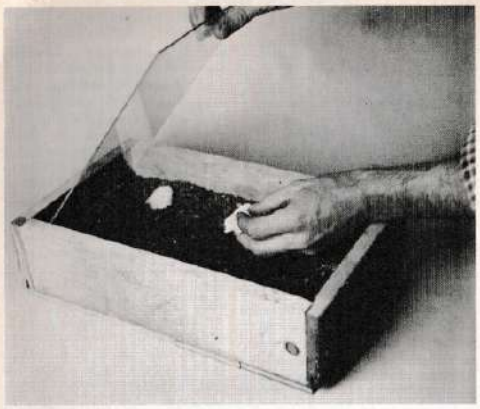
"White worms can sometimes be gathered from soil culture boxes as one-inch balls by means of a spoon and fed directly to the worm-cleaning tank prior to feeding fishes. If too many worms are just dropped into an aquarium, some may escape and hide among the pieces of gravel or other crevices present in a tank.

White worms. Photo by G.J.M. Timmerman.

where they eventually die and pollute the water.

"Containers used for culturing white worms include the following: unpainted wooden boxes (of all sizes, but 7 x 10 x 3 inches is probably best), plastic boxes, flower pots, poured concrete boxes, ceramic dishes or crocks, regular cigar boxes if available, dish pans, glass culture dishes, tin cans, garbage cans, wooden barrels sawed in half, insulated picnic boxes, styrofoam shipping boxes, refrigerator liners, or large metal (or plastic) water-lily pools. Size is actually not too important as long as it fits into one's plans, needs, etc., but it is absolutely necessary that the moisture of the soil be retained by the use of tight-fitting covers of some kind even though they be nothing but moist burlap bags.

"Temperatures should be maintained at about 60 degrees Fahrenheit for best results, which limits this to a winter-time activity for many aquarists. At 75 degrees the worms die; at 55 degrees they will



Food is being added to this white worm culture, housed in a home-made culture box. Photo by Robert Gannon.

not breed. Stone fruit cellars which used to be so common on farms make ideal culturing sites even during the summer months because of this temperature requirement. Spring houses, too, especially those made of concrete blocks are very satisfactory in which to keep the worm boxes.

"Light must be indirect and subdued, and any use of electrical lighting while moving boxes, etc. should be kept at a minimum. Construction of the building or room in which worm containers are kept should be vermin-proof, if at all possible, to keep out rodents and insects, especially ants. A capability for complete aeration of the room or building is strongly advised.

"Soils recommended include the following: African violet soil [sold commercially], black loam, mixtures of loam and leaf mold, well manured sandy garden dirt, black loam from a deciduous (not evergreen) forest, untreated loam from florists, 1:1 mixture of good garden loam and peat, forest humus, loose non-crusting soils free of chemical fertilizers, soils that do not contain clay, light soil with plenty of rotting vegetation, sieved garden loam, sterilized potting soil mixed with sterilized peat moss, crumbled leaves and dry grass, leaf compost, bulb fiber, rich woods dirt, pure peat moss, and even 1/8 inch gravel in place of soil. It is obvious that clay, large amounts of sand, and chemical fertilizers are to be avoided in the base in which worms are to be grown.

"The ideal "soil" would have the following characteristics: 1) does not cake or become tightly packed so that there is some air available beneath its surface; 2) does not readily turn sour; 3) will hold sufficient moisture without getting soggy; and 4) will enable white worms to move about freely.

"Some of the foods suggested for use as worm food are milk (both sour and sweet), bread (all kinds), rolled oats (cooked or uncooked), Pablum, pasteurized wet cow manure, powdered milk, cake, mashed potatoes, dog biscuits, fruits, vegetables, baby foods, cottage cheese, malted milk, cornmeal, chicken egg mash from farm stores, soda crackers, bone powder (actually for controlling pH), table scraps, egg whites, canned corn, thick buttermilk, and cottonseed meal."

The richness of this white worm culture is visible as the worms are being lifted in a clump of soil. Photo by Robert Gannon.

Electric Catfish

Q. Could you please furnish me with some data regarding the electric catfish.

1. Can it get along with a jack dempsey (*Cichlasoma biocellatum*) of equal size, or would it be too shocking an experience?

2. How does it produce electricity, and what organs are involved?

3. How can I measure its output in volts? What meter should be used?

4. Does the electric capacity grow as they grow?

Mr. C. Pine
Brooklyn, New York

A.1. *It probably would get along as well with a jack dempsey of about the same size without electrocuting the cichlid, but it would be best to keep the electric catfish by itself.*

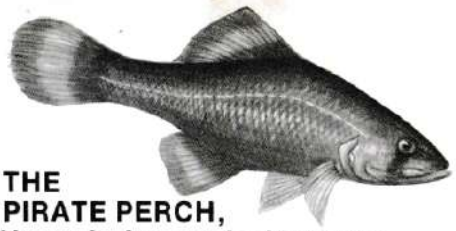
2. The fish has special electricity-producing organs running along its flanks.

3. To measure its output in volts you'd have to use a voltmeter.

4. Yes, the fish grows in electrical discharge potential as it grows larger.

TOLEDO BETTA SHOW

August 21 and 22 are the dates for a betta show to be held by Toledo Area Betta Breeders (a chapter of the International Betta Congress) at the Southwyck Mall in Toledo, Ohio.



THE PIRATE PERCH, Nature's Anatomical Wonder

by John R. Quinn

There probably isn't another North American native fish that can surpass that morose-looking oddball of a creature called the pirate perch, *Aphredoderus sayanus*, in terms of just plain oddness. The specific name gives a clue to the oddball's oddness: with age, the fish's anus migrates from the "conventional" position just ahead of the anal fin to a point under the head, where one would normally envision the fish's throat to be found.

My first contact with the pirate perch occurred about eight years ago, when one turned up in the seine after a haul through a weed bed in New Jersey's Pine Barrens. We were looking for (and getting) black-banded sunfish, and the pirate perch's sooty blackness (quite like that of a bullhead catfish) was immediately apparent as it lay amid the more impressively tinted bodies of the small sunfishes that were also caught in the same hairgrass and rush beds at the lake's edge. A close scrutiny revealed a small, rather big-headed fish with darkly pigmented body and fins and displaying the aggressive bass-like mouth of a predator. Having had no prior experience with it, into the collecting jug and home to the tank he went in what was to be the beginning of a long and interesting (for me, anyway) relationship.

In the controlled environment of the home aquarium, I found the pirate perch to be a predominately nocturnal animal. Daylight hours found them (I collected several that day) lodged in the plants or rock crevices in a lethargic state, but a flashlight played into the tank late at night revealed a different story. Fishes that disported and darted about during the day now slumbered(?) peacefully amidst the *Vallisneria*,

while here and there a somber shadow was spotted moving along the gravel in what seemed like purposeful movement. A closer look revealed our subject, body a-shine with iridescence and eyes glowing, moving about as fast as a pirate perch ever does—a creature of the night in search of prey.

The pirate perch pursues its more or less solitary existence over a considerable area of North America, from the Mississippi Valley east to the Atlantic coastal plain and thence south through Florida to Texas. But nowhere within this range could the species be considered an abundant or common fish, usually turning up in a rather isolated "pocket populations." One such pocket is the New Jersey Pine Barrens region, where *Aphredoderus* is present in regular abundance in the cedar swamps and cranberry bogs, although it rapidly diminishes in numbers as one reaches the fringe areas of the pines.

Though the pirate perch is an inoffensive, fascinating oddity in nature, it is in the home aquarium that we encounter its drawbacks. Being by nature a predaceous fish, the perch has a rather large mouth, and if a large (5-inch) specimen is kept in the company of smaller fishes, you may begin to notice a general thinning out of the tank tenants, as well as nipped tails on those of greater size. Being of such demanding gustatory nature, these fishes will not accept 'fish food' of any kind (in my experience anyway), and, like pickerel, will accept live foods only; minnows, earthworms, *Daphnia* and mosquito larvae are the preferences in about that order.

Our next point against the perch's desirability as an aquarium fish is its retiring nature and dislike of open areas. The species undoubtedly does best in heavily planted surroundings, so an aquarist desiring to show off his little-known prize to a visitor will find a set of planting sticks indispensable in routing it out of hiding so that his guest may cast a dubious eye on the uninspiring little creature hanging there in the water before him in its characteristic head-down pose. After sitting motionless for a few seconds, it turns and darts into the shrubbery, leaving the observer to wonder what all the fuss is about!

Indeed, the pirate perch's interest for the aquarist lies not in its scant beauty, or alert, winning personality (it has none to speak of) but in its very strangeness. Most experienced 'fish freaks' have never seen one, and to my knowledge no one who has kept them has induced them to spawn. Those I've kept

As these photos show, the coloring of the pirate perch is basically somber; no matter what the mood or condition of the fish is, it remains a fairly uniform and unrelieved shade of brown or black. Photo at right by Braz Walker; photo below by Aaron Norman.

have evinced literally only passing interest in each other; when they meet by accident, the usual reaction is a rather unsociable nip and an about-face, and off they go in that curious rowing motion they employ to get around.

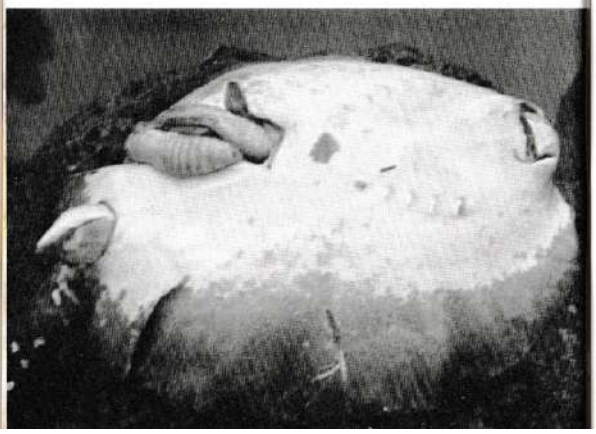
This is one of nature's oddballs that needs more work and observation by naturalists and aquarists alike. Who knows?—this antisocial hermit of the finned world may have many more surprises in store!

Breeding a *real* problem fish: The Freshwater Stingray *Potamotrygon laticeps*

They don't do it anywhere but Detroit.

by Kim Cottrell

Freshwater stingrays are not often seen in home aquaria, primarily because of the relatively large tank size required to keep and raise them. Other reasons for their scarcity in hobbyists' tanks are their relative scarcity on the market and their high price, coupled with their reputation for being difficult to keep. When stingrays are exhibited, however, their hovercraft movements, protuberant eyes and window-washer charades as they sweep their ventral sides up and down aquarium walls make them invariable attention-stealers.



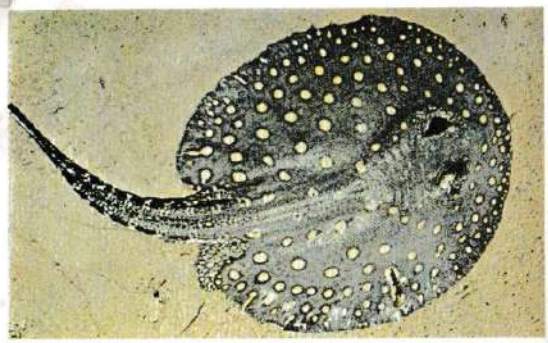
This female stingray, captured by Amazonian Indians only a short time before this photo was taken, has given birth to two babies and is in the process of being delivered of another. Photo by Harald Schultz.

A baby stingray has been placed on the stomach of its mother for size comparison. Even a large fish like the wild-caught female *Potamotrygon laticeps* shown here can deliver only a few baby stingrays at one birth. Photo by Harald Schultz.

These carnivorous livebearers have a natural range which encompasses much of the South American continent, from the Orinoco and Magdalena basins in the north through the rivers of Ecuador and Peru and south 2500 miles through the Amazon, Paraguay and Parana river basins to Argentina.

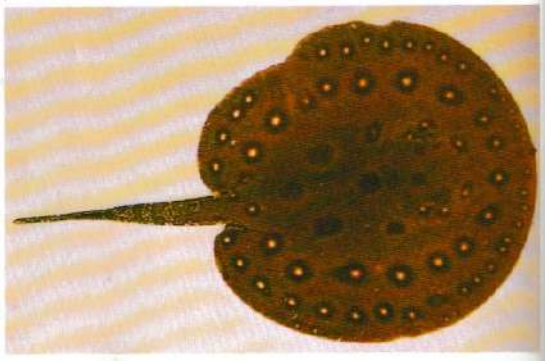
Here they are often more feared than the infamous piranha. They carry on their tails a barbed and venomous lance-like spine up to four inches in length. They lash out with this spine, perhaps by reflex action, at any hapless native who inadvertently steps on their disc-shaped bodies as they lie on the bottom in turbid shallows. The wound is said to be quite painful and slow to heal.

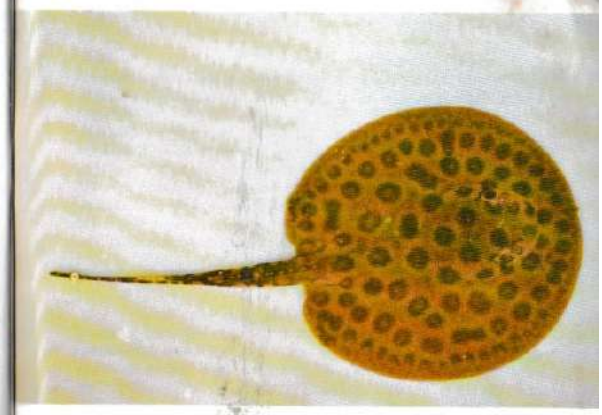
Virtually any freshwater stingray specimen seen in this country was captured in the wild, as the only known breeding pair in captivity is kept at the Detroit Public Aquarium. This pair (they are of the species *Potamotrygon laticeps*) was ac-



Potamotrygon laticeps, the species successfully maintained and spawned at the Detroit Public Aquarium. Photo by Harald Schultz.

The various species of freshwater stingrays of course vary greatly in markings from species to species, but they all share in the basic body shape of a circle-with-a-handle. . . and they all bear the potentially damaging barbed spines in the tail. This species is *Potamotrygon motoro*. Opposite, above: *Potamotrygon* species; opposite, below: *Potamotrygon reticulatus*. Photos by Dr. Herbert R. Axelrod.





quired in 1962 and has been bred four times, initially in 1969. The Detroit Public Aquarium also lays claim to being the oldest public aquarium in the Western Hemisphere, having opened in 1904.

The stingrays are a star attraction there, and although priority value is placed on them, they receive about the same amount of professional attention as paid the other species kept. Curator Jim Langhammer says that inducement to breed in this species has been pretty much a matter of providing an appropriate environment for a long enough period of time. The seven-year span between the acquisition of the young rays and initial breeding activity observed here may be indicative of a relatively late sexual maturity.

The highly depressed form of these bottom-feeders obviously requires that they be given adequate floor area. The female of this pair is 17 inches in length and 16 inches across, with an 10-inch tail; the male is 14 inches in length and 13 inches across, with a 7-inch tail. They're kept in a tank of approximately 400-gallon capacity, with a floor area measuring 52 inches by 42 inches, and are soon to be moved to another show tank about 50% larger. There are reports of individuals in the wild attaining lengths of 48 inches. Males are easily identified by their two claspers, one on either side of the tail, extending from the interior of the pelvic fins.

The rays' ground color on the dorsal side is deep brown, spotted uniformly with solid darker circles, in a kind of mottled paisley effect. Color intensity changes can be observed throughout almost any 24-hour period, presumably reflecting mood differences. The ventral side varies from a light gray to a stark white.

In true elasmobranch style, *P. laticeps* breathes in through spiracles, dorsal side apertures which operate as seal-

able one-way valves. Water is then expelled through a double set of gill slits on the ventral side of the body. Their skeletons are of course made up entirely of cartilage, and they have no gas bladders, which seems to bother them little as bottom-dwellers.

The Detroit pair are fed large worms, chopped Pacific herring, and goldfish and minnows, which they surprisingly can catch by trapping the feed fish against aquarium walls, their mouths being on the ventral side. They are fed to satiation, so there are no additional feedings for the gravid female.

Major water changes, at least 25% weekly, are an important part of the rays' care. Detroit's water is about ideal in hardness and pH, testing out at around 7.2-7.3, and no chloramine is added, so new water is introduced directly. A temperature of 78° F. seems to be right for these fish.

Rays are oviviparous, producing eggs which are fertilized and hatched within the female's body, so that the young are born alive. The gestation period for the species has been stated in various ichthyological literature to be about two years, but this has certainly not been the experience here—there were two birth groups within one 12-month period several years ago. Jim Langhammer believes gestation spans three to four months, or perhaps a little longer.

The rays' dorsal integuments are covered with hard dermal placoid scales. During courtship the male nibbles the female, leaving disc-shaped scars, and these copulatory bites may account for some of the semicircular healed scars mentioned in other literature, and presumed to be healed wounds from unsuccessful would-be predators.

These bites heal quickly, and two to three months later the female appears very gravid, with pronounced dorsal bulges, the condition of the female at the time of this writing. At this time one can actually see the embryos turning within her body.

The ray fry are four to five inches in length at birth and are immediately free-swimming; indeed they appear to be perfect miniatures of the species. The largest birth group at the Detroit Aquarium numbered four fry; there were two groups of three individuals each and one with only two.

The fry are removed immediately, not to protect them from parental attack but rather to monitor their feeding. They're placed in a 20-gallon tank over finely grained, lightly

colored "sugar" sand so as to easier observe metabolic waste that provides proof of their having commenced feeding. Chopped worms, fish and snails are offered, with sufficient water changes to keep decomposing uneaten food from contaminating the tank. It may be several weeks before they will take food, and the last group finally responded favorably to mashed, rather than chopped, minnows.

Although no definite breeding season has been observed here, the majority of the births took place during the winter, corresponding to the South American summer. Fry growth is at a rather slow pace, but no disease problems have been encountered with the young or the adults.

It has been observed that the barbed spines or stings, which can be as wide as 3/8" at the base, sporadically fall out and are replaced by new spines which appear prior to the shedding.

Freshwater rays of smaller proportions make colorful and exotic tank residents, and for those with the time and facilities who wish to be among the first to breed a species, they literally provide a sizable challenge. **c.f.h.**

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