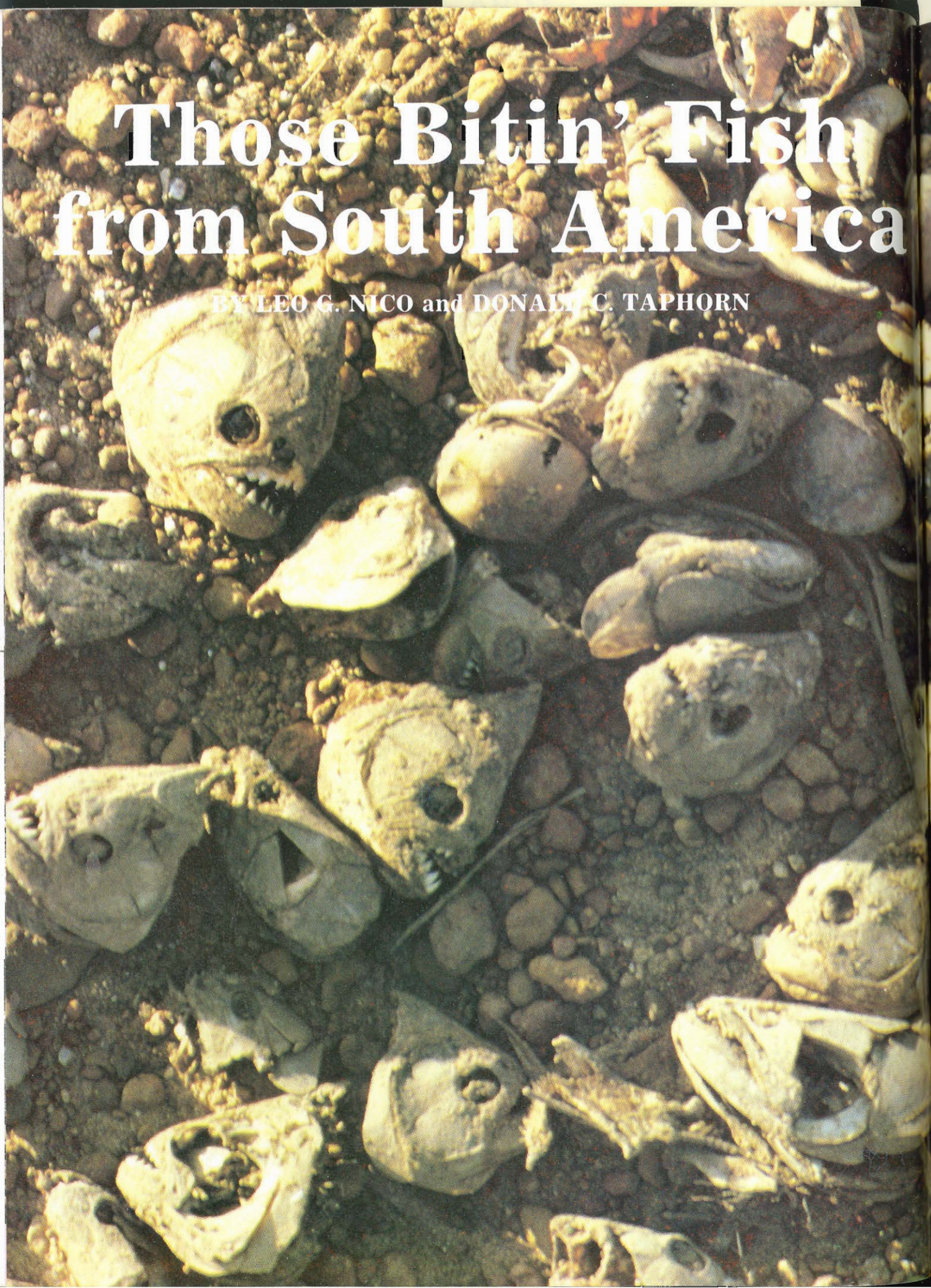
# Those Bitin' Fish from South America

BY LEO G. NICO and DONALD C. TAPHORN



A few years ago some friends came down from Maracaibo, a big, sprawling, oil-built city on the coast of northwestern Venezuela, for a fishing trip. After traveling the narrow snaking roads that cross the mountains, they reached our home in the eastern foothills of the Andes, and from there we continued on south for several hours heading towards the Apure River. During the ride, we talked of the successes of past trips, of the big ones that got away, and of the different kinds of fishes we might catch. Since this was the first trip to South America for our friends' father, a retired Missourian and avid bluegill and bass fisherman, we had a lot of information to share (there are about 60 species of commercial fishes in this area, all of them potential challenges for the angler). We told him about the meter-long striped catfish *(Pseudoplatystoma)*, the 25 kilo pacus *(Colossoma* and *Piaractus)*, freshwater stingrays *(Potamotrygon)*, electric eels *(Electrophorus)*, the giant (over 2 meters) river cats *(Brachyplatystoma)*, the palometas *(Mylossoma)*, freshwater drum *(Plagioscion)*, and many more.

When we finally arrived we changed into our worn field clothes and old tennis shoes so we could seine in the shallows along the muddy shores of the Apure, leaving our friends to their bank fishing with hook and line. Our netting was productive; besides the usual assortment of characins and small pimelodid catfishes, we caught a rare, bright green auchenipterid catfish. After an hour or so of seining, we were satisfied and hiked back toward our makeshift camp. When we got around to the older gentleman's spot to ask what he had caught, he replied with a trace of disappointment, "Well, not much, just a bunch of those bitin' fish." Somehow we had neglected to warn him about the fish most likely to take his bait, the ubiquitous piranha. Fortunately, he had noticed their formidable array of teeth (they are hard to miss because a piranha comes out of the water with jaws snapping) and had carefully avoided an accident while unhooking his catch. His descriptive name for those red-bellied fish he'd never seen before was quite appropriate, and to this day we still jokingly call piranhas "those bitin' fish."

The Venezuelan *llanos* of the Orinoco River Basin—where for several years we have studied Neotropical fishes—consist of vast expanses of low-lying, open savannah. This area of the world has redefined the meaning of the word "flat." The slope, or natural lay of the land, is so slight and gradual that the drop in elevation as you approach the sea may be only a few inches per mile. The *llanos* stretch some 1,000 km west up from the sweltering mangrove swamps of the Orinoco delta, clear across the heartland of Venezuela and on to the Andes Mountains, and extend far into neighboring

The end of the line for a group of large piranha. Many of the predatory characins become trapped in receding pools at the onset of the dry season. Photo by Leo G. Nico.

Colombia, where the savannah vegetation eventually grades into the lush rain forests of the Amazon. The Apure River, one of many large tributaries of the Orinoco, winds its way through the west-central Venezuelan *llanos*. Over much of the Apure's length it is bordered to the north by the high *llanos* where large tracts of dry tropical forest are fairly common, and to the south by the low *llanos*—an area characterized by extensive grassland savannahs. Though the *llanos* are well within the tropics, their usually sparsely-wooded plains are a far cry from the "jungle" that many North Americans envision as the dominant vegetation of South America.

The *llanos* is also a land of incredibly varying weather. There is no cold winter, of course, but rather a wet and a dry season. The wet season is very, very wet. In some places, during the eight rainy months (April to November) as much as 108 inches of rain will fall (though the average is half that). The rains in the *llanos* are sometimes so torrential that visibility is reduced to less than 6 feet in front of your nose. Indeed, we've seen as much as 3 inches of rainfall in less than an hour. Because they are so flat, the *llanos* don't drain rapidly, and with so much rain falling on them they flood extensively during the wet season. Often the water stretches unbroken from one horizon to the other. It rains so much in fact, that even though the Orinoco drainage is only a quarter the size of the Mississippi drainage, it carries about the same amount of water to the sea.

The dry season is very, very dry. The rains just stop, period. The savannah, covered with several feet of water in the west season, dries up and literally burns to a crisp. Brush fires, usually started by llaneran cowboys and other rural folk, rage unchecked for miles making quick work of the dying tall grasses that had flourished during the wet period. From December to March the skies are often filled with a gray haze instead of rain clouds and ashes fall to the earth, adding to the overall appearance of desolation that takes hold of the landscape. Just about all the fishes die.

However, in April the rains come again and the cycle continues, as it has for many thousands of years. The land turns green once more as the grasses sprout anew. The water rises. Fishes that survived the dry season by taking refuge in permanent waters—rivers, large caños, mountain streams, and deep lagoons—spread out to recolonize, repro-

duce and feed in the shallow freshwater sea.

It is hard to imagine this change of seasons, it is so drastic and complete. But even so, the *llanos* supports an incredible variety of life. Wild ducks, geese, storks and herons, ibis, turtles, frogs, caimans and crocodiles, anacondas, manatee, freshwater dolphins, river otters and capybaras all make these floodplains their home. And of course there are lots of fishes—well over 500 different species (compared to only 325 or so in the Mississippi Basin)—each with some special adaptation or strategy to make it through the "crunch" of the annual dry season.

One of the most common kinds of fishes in the *llanos* are the piranhas. In Venezuela they are called *caribes,* after the fierce, cannibalistic Indians who once occupied the Caribbean area. The piranhas are strictly South American and belong to the Characidae, a particularly large and diverse family that also includes the tetras, silver dollars and the large vegetarian pacus. Piranhas in the Orinoco Basin are highly successful in terms of both number of individuals and number of species. The basin is very large, has a tremendous diversity of aquatic habitats, and is connected with the Amazon Basin by way of the Rio Casiquiare-Rio Negro system. Of the approximately 35 piranha species in South America, about a dozen or so live in the Orinoco Basin. We can't be more precise since the taxonomy of piranhas is in confusion and no one is certain just how many species of piranha actually exist. Perhaps the best general source of information on piranhas is Myers (1972). But to put a name on a specimen you need good taxonomic keys, and none that have been published so far seem to work very well. That leaves the original descriptions of the various species, but more often than not they are so outdated or poorly done that they lack essential details that would permit accurate identification. Thus, some of the scientific names used here and elsewhere will change as the taxonomic relationships of piranhas become better understood. Dr. William Fink and Dr. Antonio Machado-Allison have taken up the task and are in the process of reviewing and revising the group.

Piranhas are particularly interesting to us because they exhibit such a wide range of morphological, ecological and behavioral traits. There is a gradation in body shape from pointy-snouted, relatively thin, streamlined species, such as the pike

A spawning pair of *Pygocentrus* (often considered to be a subgenus of *Serrasalmus*) *nattereri*. Note the dark body color spangled with bright spots. Photographed in an aquarium by Hiroshi Azuma.

piranha *(Serrasalmus elongatus)*, to the blunt-headed, bulldog-like species, for example, the red-bellied piranhas *Pygocentrus notatus* of the Orinoco and *P. nattereri* of the Amazon. Many physical characters overlap between the various species and, to add to the woes of taxonomists, a few species undergo rather marked changes in body shape with increased size and age. Géry (1972) showed how *S. rhombeus*, also called the red-eyed piranha, grows from a pointy-snouted, long-bodied juvenile into a large, deep-bodied adult. The Orinoco red-bellied piranha, the pinche piranha *(S. eigenmanni)*, and the pike piranha are more conservative. We have collected many very small specimens that are very similar to adults in overall body form.

The largest known species of piranha is *S. piraya* from the Rio Sao Francisco of eastern Brazil. We have never seen it, but Myers (1972) reports that they commonly reach a total length of some 20 inches. *S. rhombeus* and *S. niger* (possibly synonyms) can reach about 16 inches Standard Length (SL, the length from tip of snout to base of caudal fin). Very large red-bellied piranhas probably never get much over 13 inches SL. Most other species rarely get larger than 10 inches to the base of the tail.

Neotropical fresh waters can be divided into three general types based on water chemistry and color, although some aquatic habitats are intermediate. Black waters have low pH (high acidity), low nutrients, poor light penetration and few suspended sediments. Such waters are tea-colored due to the high content of humic matter (an effect you can mimic by placing rinsed, fibrous peat moss in the aquarium filter). Many blackwater streams arise in sandy soils of the plains where dense gallery forests or swamps provide a constant supply of leaves and wood that decay and leach organic acids into the water. Rivers are so darkly stained in some areas that even when viewed from nearby the water appears black and forbidding. But, if you go diving they reveal themselves to be reasonably clear, albeit tea-colored, and visibility can be very good—over 6 feet in some cases.

Some blackwater rivers of the Orinoco Basin are fed by clearwater streams which originate from the Guyanan Shield (Welcome, 1979) or similar mountainous, rocky land masses. Like the blackwater areas, these clearwater streams are usually poor in nutrients and have a low pH. Such streams typically have a moderate to fast current and a bottom ranging from sand to large boulders.

The third category, whitewater rivers like the Apure, are turbid and muddy, full of sediments, and rich in nutrients. In whitewater rivers and their floodplains aquatic productivity reaches its peak, resulting in an incredibly high biomass of fishes. Although piranhas can be found in all three types of water, like many other tropical species they reach their greatest numbers and diversity in whitewater. During the dry season, when fish density is high, we have caught as many as four different kinds of piranhas with one short pull of the seine or a single toss of the cast net. Though many species, such as the red-bellied piranha of the Orinoco, are found in all three situations, as well as in both running and still water, most tend to be more common in one particular type of habitat. A few seem to be limited to a single kind of aquatic habitat.

Whether the distribution and abundance of piranhas are a result of physical and chemical factors (e.g., pH and dissolved oxygen) or biological factors (e.g., predation and competition) is not yet known. Most likely it is a combination of both. Piranhas are, for the most part, restricted to lower altitudes; we have very rarely collected them in mountain streams. The swift flow, cool water, and very low fish density characteristic of such sites may prevent their occurrence.

We have examined the stomach contents of over one thousand piranha specimens of seven different species in a study of their food habits. Our findings show that pointy-snouted species specialize on the fins of other fishes and occasionally scales. This agrees with studies of Amazonian piranhas (Roberts, 1970; Goulding, 1980). Blunt-headed species prefer fish flesh, usually taking small fish whole or nearly whole. Species between the two extremes in body shape show a combination of the two diets. Food habits vary among the different size classes,

*Serrasalmus eigenmanni*

*S. eigenmanni*

*S. eigenmanni*

*Pygocentrus notatus*

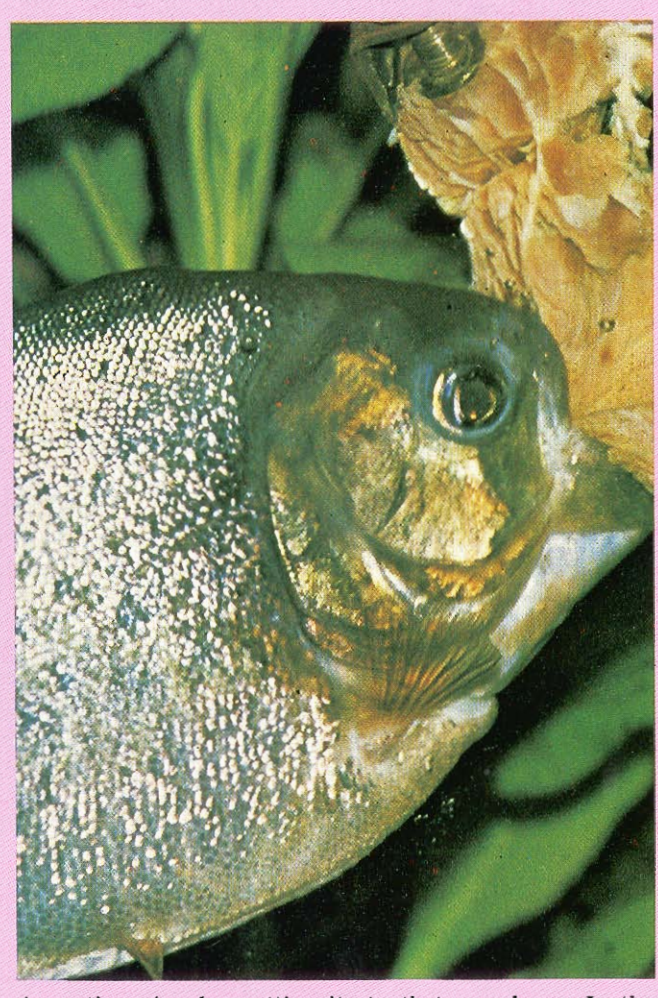
*Pristobrycon* sp.

*Pygocentrus notatus*

*S. elongatus*

*Pristobrycon striatus*

Photos by Leo G. Nico and Donald C. Taphorn.



A captive piranha putting its teeth to good use. In the aquarium, piranhas should get an ample amount of fish and meat fare if they are to coexist without conflict. Photo by J. J. Van Duinen.

as well as from season to season, even within a single species. Goulding (1980) found that some piranhas even resort to eating fruits that fall into the water in streams and flooded rain forest of the Amazon.

Orinoco red-bellied piranhas, when less than 1.5 cm (about 0.6 inches) SL, feed primarily on cladocerans and copepods, but gradually switch to aquatic insects as they grow; by the time they are about 3 inches SL they are almost entirely piscivorous. The pinche piranha is more specialized in its food habits. Although very small individuals also take tiny crustaceans, those larger than 1 inch SL restrict themselves almost exclusively to the fins of other small fishes. Adults of the pinche piranha take fins of medium and large-sized fishes as well as pieces of flesh or whole small fish.

In aquaria, the pinche piranha moves among other fishes, slowly positioning itself until within easy striking distance. It then attacks rapidly, grabs hold of an unpaired fin with its long jaws and, using its own body for torque, it then twists violently until it comes away with a piece of fin. On one occasion, while snorkeling in a small clearwater stream, we spent some time observing a small pinche piranha traveling with a school of 20 to 30 silvery characins. Its similar size and ability to imitate schooling behavior enabled the piranha to repeatedly bite pieces from the fins of some of its unsuspecting associates without alarming the entire school. Fin-eating piranhas are a main reason why ichthyologists use Standard Length when measuring the size of fishes, as opposed to Total Length (TL, the length from the tip of the snout to the end of the caudal fin). The tail of many fishes is often incomplete or partially regenerated. Even the blunt-nosed piranhas are regularly preyed upon in this manner by their pointy-snouted cousins.

*S. rhombeus, P. notatus,* and the common *Pristobrycon* piranha of the Orinoco all seem to rely more on a sit-and-wait strategy of feeding, though they will readily attack animals in distress, such as fishes tangled in nets or concentrated in the bag of a seining net being pulled across the water. Red-bellies may also patrol the shallows in groups, actively seeking schools of characins. In nature and in aquaria, *Pristobrycon* usually seek cover among logs or rocks, striking out at passing fishes. When unsuccessful in their attack, they simply return to the same cover or move to another location which provides some shelter. Groups of Orinoco red-bellied piranhas ranging in size from five or less to sometimes several hundred individuals often lie in ambush along the edges or downstream of fast flowing waters where they pick off unsuspecting characins swept by, or struggling up against, the swift current. *S. rhombeus* are more solitary as adults, but may also use similar ambushing techniques to hunt their prey. The species is also nocturnal, while the others are usually most active during the day. Though a small piranha may be satisfied with a fin, the larger ones, given the opportunity, are just as likely to take the whole fish or clip out a piece of flesh. But unless a fish is unhealthy or in some way distressed, larger fishes are usually alert enough and quick enough to avoid serious piranha attacks. Probably only the more streamlined piranha species, such as the pinche piranha and the pike piranha, have much success with chasing down healthy fishes in open water, but as already mentioned, they are primarily fin-biters. More observations are needed to understand the different hunting methods of piranhas.

Although fishes are by far the main prey of piranhas, every once in a while other vertebrates are taken as food. In the stomachs of the Orinoco red-bellied piranha we have found bird fragments, the flesh and skin of a snake and a young caiman (a South American crocodilian that looks like an alligator), and hair and flesh of small mammals. Piranhas even specialize on non-fish items during part of the year at some sites. These predators are often

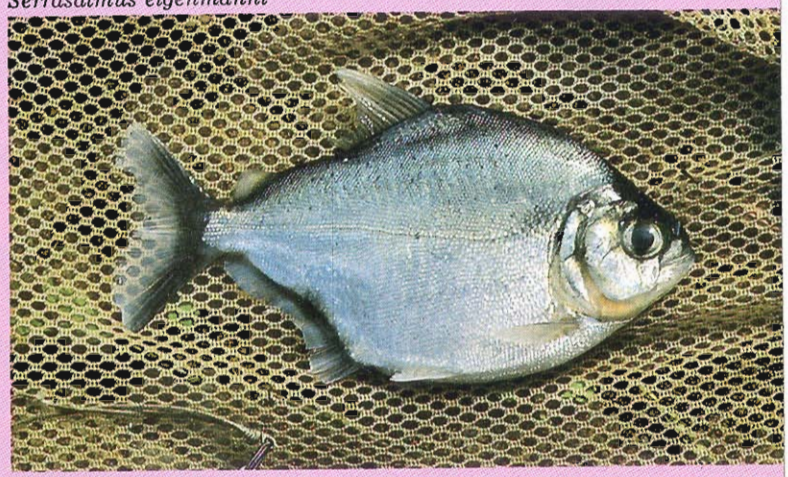
*Pristobrycon* sp. Orinoco Basin.

*S. elongatus*

*S. altuvei*

*Pygocentrus* (top) and *Colossoma*.

*Serrasalmus eigenmanni*



*Pygocentrus striolatus*

Seine haul of small characins, Estado Apure.

Seining at Cano Maporal, Estado Apure.

Photos by Leo G. Nico and Donald C. Taphorn.

A very young juvenile of an unidentified *Serrasalmus* species. Photo by Aaron Norman.

teeming in the water beneath trees used as rookeries by aquatic birds, fiercely attacking anything that happens to fall to the water, including nesting material and dropped food. On one occasion, a young cormorant had fallen from its nest. Immediately the bird was hit repeatedly from below as it tried to swim to safety, within a minute it was pulled under. By the time several large caiman had converged on the spot to investigate the cause of the commotion, even the feathers had disappeared.

We are only beginning to gain insight into the growth and reproduction of piranhas in the wild. Our best data come from sites where we have made monthly collections of over a period of a year or more. Like the majority of fish species in the tropics, piranha reproduction is closely tied to the cycle of wet and dry seasons. The Orinoco red-bellied piranha, from about 5 inches SL and larger, mature sexually just before the start of the rainy season. With the onset of the rains, usually in April, spawning begins, and continues until about July. During most of the year the red-belly is silvery, with a bright red-orange belly (hence the name). Some of the fins are marked with red and edged in black. During the spawning period the large sexually mature adults, both males and females, turn black, with flecks of glittering gold or purple. Even the fins are black or darkly pigmented. Like trout, the body color at this time is photochromatic—that is, highly sensitive to light. If you cover part of a "black" piranha lying on the sunlit shore with a towel, the covered area will lose its color rapidly.

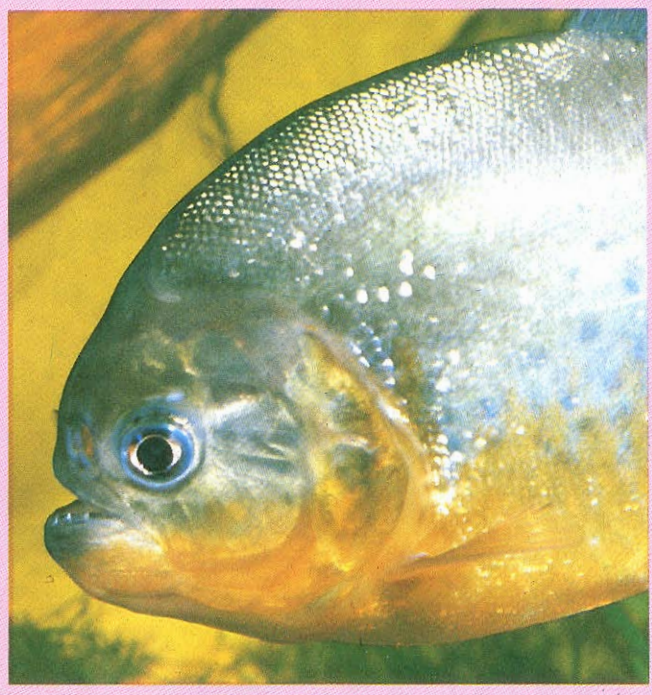
Other species also turn black, or darker, during their reproductive period. *S. rhombeus* apparently maintains the black color the year round after it reaches a certain size. The pinche piranha of the Orinoco tends to be darker when in reproductive condition, but we have not seen black individuals of this species. We have also not observed a black phase in mature *Pristobrycon* nor in the highback piranha *(S. altuvei)*. It should be mentioned that because of the light and dark phases displayed by some species, some scientists of the past have probably described two species when they were actually dealing with one.

Although a few species of piranhas are now bred in aquaria, nothing much is known concerning spawning in the wild. During the early wet season small groups of large black *P. notatus* are found concentrated in shallow grassy areas near shore. Perhaps males set up small breeding territories, waiting to spawn with passing females. Nest-guarding has been reported in piranhas kept in captivity (Myers, 1972).

Those caribes that eat mostly fish flesh grow fastest. For example, the Orinoco red-bellied piranha reach 5 to 8 inches SL by their second rainy season. Fins and scales aren't as nutritious as flesh and bone, and species that specialize on these items have a lower growth rate; the pinche piranha probably never gets longer than about 6 inches SL at an age of one year. But the fin-eaters also usually mature at a smaller size.

Most piranha species have some red on the anal fin, belly and chest. The amount of red and its intensity does vary, however, from species to species and among individuals within the same species. Those that feed heavily on the flesh of other fishes, when not in reproductive condition or of a very large size, show the greatest intensity of red. This color may serve as a species recognition signal to help avoid being bitten during group feeding. It appears that mimicry also occurs. Mago-Leccia (1970) and Machado-Allison (1982) drew attention to possible piranha-mimics when they noted the remarkable similarity in coloration and body shape between vegetarian pacus or cachamas (for example, *Piraractus brachypomus)* and the Orinoco red-bellied piranha. It's still not known whether the similarity allows cachamas to escape predation by red-bellied piranhas, which may perceive them as one of their own, or prevents attack by other fishes, which mistake them for piranhas. An amazing variety and number of other fishes associated with piranhas also have red fins or bellies, perhaps for reasons of their own—such as mate attraction or schooling—but if the color causes even a moment of hesitation in the piranha's attack, it could be enough to allow red-colored fishes to escape. However, careful scientific testing is needing to clarify the relationships.

The carnivorous piranhas, present but unseen in most South American waters, evoke an almost primordial fear in some. In the water man is out of his element and feels especially vulnerable and relatively helpless. Imagined fears far exceed the real dangers. But such emotions have influenced or found their way into even scientific evidence. The-



The red-bellied piranha is one of the more popular species with aquarists, especially those looking for a "pet" of a somewhat dangerous nature. Photo by Michael Gilroy.

odore Roosevelt once wrote in a letter during his exploration of the Amazon (quoted from Eigenmann, 1915)—

> "... They are the most ferocious fish in the world. Even the most formidable fish, the sharks, or the barracudas usually attack things much smaller than themselves. But the piranhas habitually attack things much larger than themselves. They will snap a finger off a hand incautiously trailed in the water; they mutilate swimmers—in every river town in Paraguay there are men who have been mutilated; they will rend and devour alive any wounded man or beast; for blood in the water excites them to madness..."

Even as ichthyologists with a collective total of nearly 10 years field work in the Neotropics, we fidget a bit whenever reading horror stories concerning piranhas written by some of the early naturalists and explorers. Should we question our sanity for selecting a profession that involves such risks? Though often exciting and full of surprises, our adventures seldom match those melodramatic tales. After scores of expeditions—collecting fish with seines (that is, literally up to our necks in "piranha-infested waters") at hundreds of sites—we have never had a mishap in the water with these "bitin' fish." Nevertheless, their notorious reputation has some basis in fact. It is true that piranha attacks have resulted in serious wounds—and, on rare occasions, even deaths. However, the great majority of stories concerning the blood-thirst of piranhas towards humans or any other large animal that wanders into the water are not supported by our experience. And often because of their rather gruesome habit of post-mortem snacking (which they share with a host of other aquatic animals, such as crabs, cetopsid catfishes, caiman, and other carrion feeders), they are unjustly blamed, when in reality death was by some other cause, such as drowning.

Most contacts between a human and piranhas involve only a single bite. For example, a herpetologist friend received a bite on the back of the leg while seining for turtles in a shallow pond. She felt no immediate pain and was able to walk back to shore, even though the quarter-sized wound was bleeding freely. She escaped without assistance and, we might add, without being attacked by a "savage school."

Experts who have tried to evaluate the danger of piranhas have sometimes come up with differing opinions (Myers, 1972; Goulding, 1982). From our viewpoint, any fish with teeth and jaws as powerful as those of the piranha deserves respect. But there are no firm guidelines to follow when collecting fishes in an area where piranhas occur. It would seem that by using common sense and trusting in the laws of probability one is fairly well protected. It would be foolish to step into a pool where piranhas are in a "feeding frenzy" (or in water below a bird rookery). On the other hand, kicking and stomping the water to scare fish into nets is one of our common practices, and the piranhas, rather than rushing to the attack because of the noise and splashing, are among those fish trying to escape. Nevertheless, in deep water it can get a bit "hairy" if a large piranha inadvertently passes close in its attempt to avoid capture by jumping over the net.

Piranhas do seem to be naturally curious about any disturbance. Whenever we have encountered big piranhas while skin diving, they approached to a reasonable distance, looked us over, then disappeared. It is most gratifying to be classified as "non-edible" in such circumstances. Perhaps we fishermen have a "psychological" advantage over piranhas in that it's a matter of who is after whom.

Piranhas are usually more dangerous out of water than in it and most bites occur on shore or in boats. As soon as they are pulled from the water, piranhas have the unfriendly habit of flopping about and rapidly snapping their jaws together while "shuddering" their heads from side to side. There have been many instances when powerful jaws closed on part of someone who was careless or slow-footed. Many fishes, such as oscars or tiger catfish, may jab you with their pectoral or dorsal spines as you attempt to remove the hook or take them out of a net, but a mishandled piranha, even a small individual, has the potential to instantly clip out a piece of flesh and inflict a nasty wound. Anyone who has handled live, slippery fishes can understand the difficulties involved. Given the

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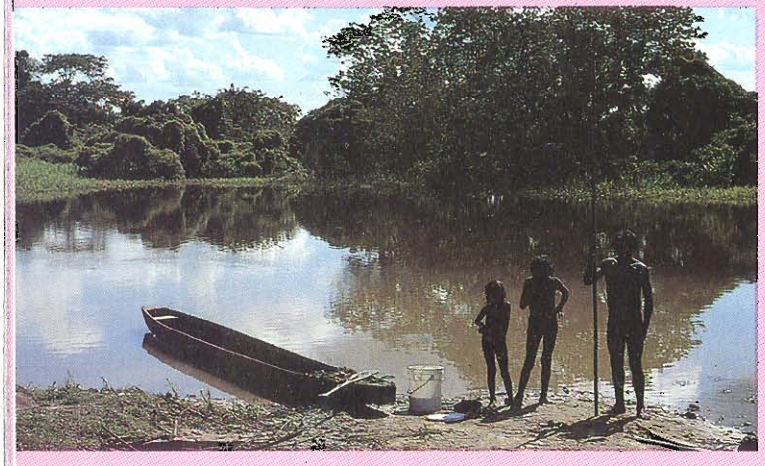

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**Photos this page: 1)** A blackwater river habitat—the Rio Yabo, Venezuela. **2)** A typical clearwater stream, the Estado Guarico, Venezuela. **3)** Muddy, or whitewater stream near Bruzual, in Estado Barinas, Venezuela. **4)** The Venezuelan *llanos*, during the "high water" of the rainy season. **5)** Enjoying breakfast at a dry season campsite in the *llanos* of southern Estado Portuguesa. **6)** A young *Serrasalmus rhombeus*. **7)** An adult red-bellied piranha, in the black reproductive phase. *Pygocentrus notatus* is the most common piranha in the Venezuelan *llanos*. Photos by the authors. **Facing page: Top left:** Small juvenile piranhas. From top to bottom: *Pygocentrus notatus*; *Pristobrycon* sp.; *Serrasalmus rhombeus*; *S. eigenmanni*. Photo by Leo G. Nico. **Top right:** A piranha bite on the leg of a collector bleeds freely. According to the authors, such attacks are the exception rather than the rule. Photo by G. Feo. **Bottom:** A large and apparently hungry school of red-bellied piranhas waits in the current below the lip of a culvert for small fishes swept downstream by the water's flow. Photo by Leo G. Nico.

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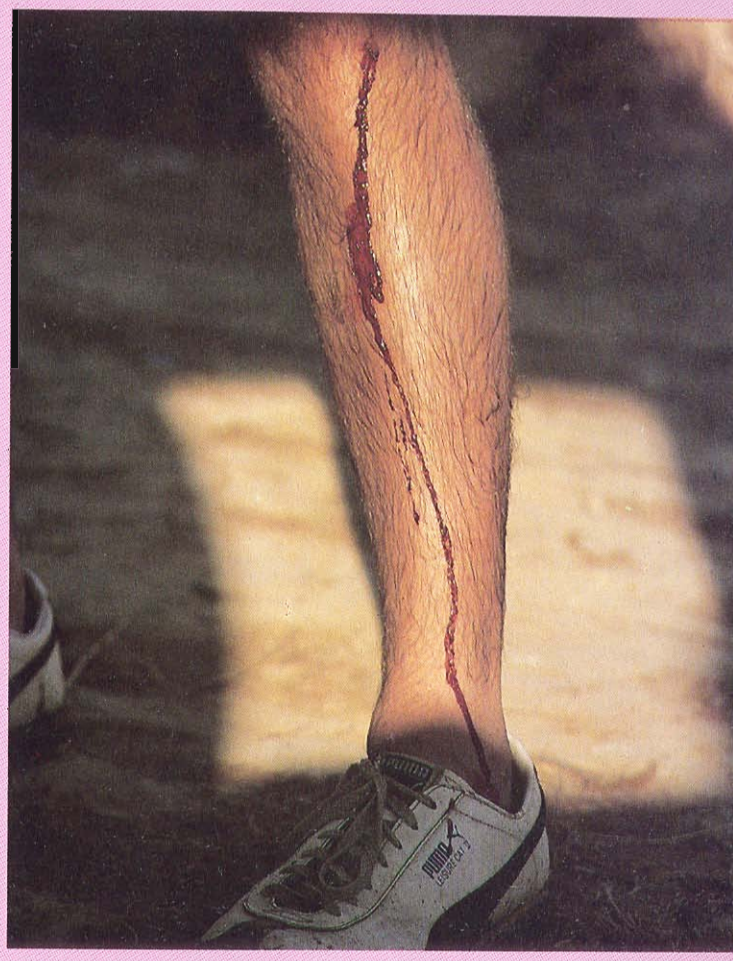

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## Bitin' Fish

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Four-month-old red-bellied piranhas in a display tank. This is about the size at which most piranhas are usually purchased by hobbyists. Photo by Hiroshi Azuma.

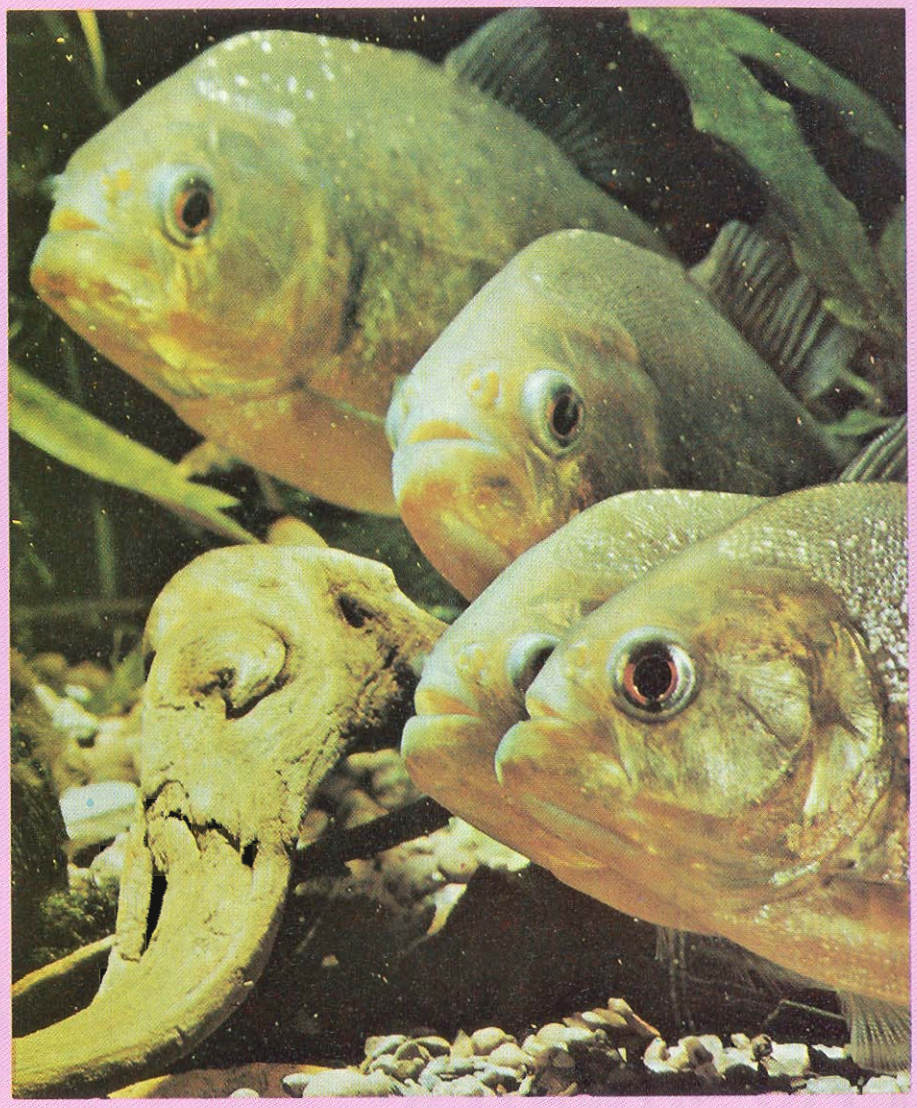
wrong set of circumstances, a large piranha could easily sever a finger. Experienced commercial fishermen carry short heavy clubs with them in their boats or canoes to stun piranhas as soon as the fish are brought aboard, thus preventing possible injury. Since biologists need to maintain their specimens in reasonably good condition, we can seldom resort to this type of safety measure.

State fish commissioners tend to become quite upset when an angler catches, to the amazement of all, one of those bitin' fish in a favorite North American fishing hole. However, except in the extreme southern states (where keeping of piranhas is often illegal) there is very little chance of them surviving the winter. If your piranhas outgrow your tank or your ability to feed them, don't release them into the wild, as they'll either starve or slowly freeze to death. Take the fish instead to a pet store, or perhaps a local museum or university. Piranhas have a place in nature, but not in U.S. waters or anywhere else outside their natural range.

Piranhas, whether as predators, scavengers, or fin-biters, have evolved in close association with the other members of their natural communities. Many aquarists' favorites—brilliantly colored little tetras, elegant angelfishes, headstanders and pencilfishes, small ornate guppies, hatchetfishes, suckermouthed algae-eaters, secretive knifefishes, and all the rest—have somehow adapted to the piranhas' fierce habits. We often wonder whether or not piranhas, as predators and fin-biters, have played an integral part in the formation of such diversity during the evolutionary history of South America. We can't say with certainty, but in those aquatic and terrestrial communities that have been well studied, it's been found that predators can act to maintain the health of the community—removing individuals that are sick or in some way "less fit."

Goulding (1980) found that fishes of the Amazon depend heavily on flooded forests. They use them for spawning, nursery and feeding areas. The large numbers of fruits, seeds, leaves, and insects that fall from the overstory are eaten by many different fishes. Thus, destruction of tropical forests has grim consequences for many species.

In the flooded *llanos,* unlike the forests, a dense growth of algae and mats of aquatic and semi-aquatic flowering plants, especially the grasses, form the base of the aquatic food web. Many fishes take direct advantage of the huge amounts of plant food that is available, for example: the algae-scraping catfishes, seed-eating tetras and herbivorous browsers such as the silver dollars. The rich supply of invertebrates—aquatic insects, snails, shrimp and zooplankton—is used as food by many fishes. Some species specialize on these organisms. The filter-feeding catfish *Hypopthalmus edentatus,* strains hundreds of microscopic crustaceans from



A group of adult red-bellied piranhas, photographed in an aquarium. This photo clearly shows the strong jaws and cutting teeth of the species, but although efficient predators, piranhas often fall prey to other animals sharing their habitat. Photo by H. J. Richter.

the water with its gill rakers as it swims along with mouth agape.

Although as carnivores they are near the top of the food pyramid, piranhas still fall prey to other animals. Big catfish swallow them whole; caiman, crocodiles and large wading birds take a share, and piranhas eat other piranhas. Some even practice cannibalism—adult *P. notatus* seem to have few qualms about eating the young of their own kind. The fin-eating piranhas are a constant menace to the blunt-headed species, but the relationship is more parasite-host than predator-prey.

Humans catch piranhas frequently and though commercial fishermen prefer to avoid them because of the damage they can do to nets, many rural people eat piranhas. They are not too bony and the flavor is similar to that of their vegetarian cousins, the pacus. So if we were keeping score, the piranhas could justifiably claim that "human infested shores are among the most dangerous in the world"—for in the end, we bite them a lot more than they bite us.

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