

# MYSTERIOUS FISHES FOUND IN CAVE POOLS AND STREAMS

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**T**HE WHITE BLINDFISHES living in the streams in caves and in other subterranean waters, such as springs and wells, have been the subject of interest and inves-

tigation since they first received public attention and description in the early 1840's. What were fishes doing in rivers deep in the earth far from any surface connection? How did they sustain life so far removed from the necessary source of all life, the sun? Why had they entered caves? Which surface fishes were their relatives? Why had their eyes degenerated? How did they find their way about from cave to cave and how did they locate food? Some of these questions were readily answered by simple observation. The answers to others are still largely incomplete, chiefly because no sustained investigation has been made of the habits and habitat of blindfishes.

Three kinds of white eyeless fishes, the **big blindfish**, **Rosa's blindfish**, and the **small blindfish**, live in the underground

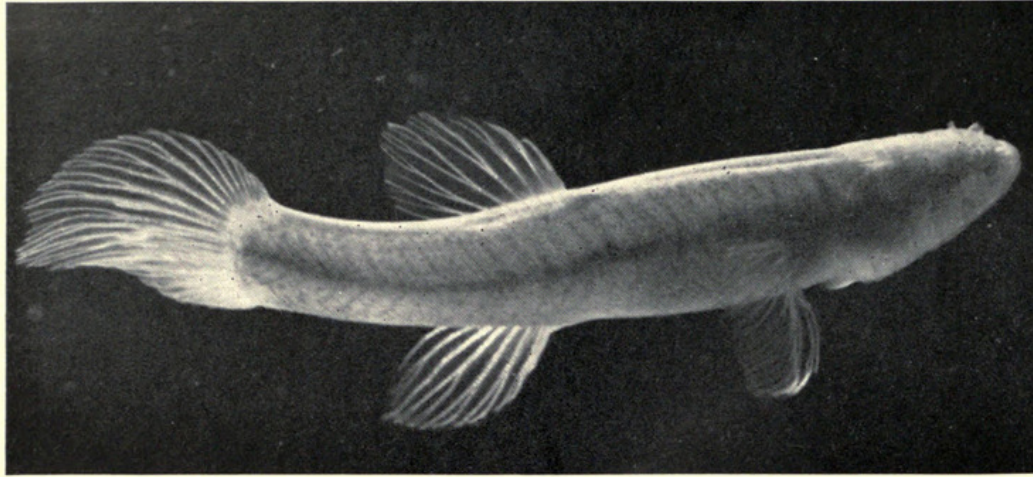
company with several kinds of eyeless invertebrates—crayfish, aquatic sow bugs, scuds, worms, flatworms, and mites. All of these are sources of food for the fishes. These invertebrates with their scavenger habits feed on vegetable debris and organic materials in mud and water when such substances are washed into the underground waters from the surface. Some feed on bat guano. Occasionally surface-dwelling fishes, such as **sculpins**, **minnows**, **catfish**, and even **sunfish**, are found living in underground streams, but they are normally colored and possess eyes comparable to those of their species living in surface waters. Although sometimes found in considerable numbers in underground waters, these surface species of fishes are probably only temporary residents and very likely leave the underground habitat to spawn or feed.

## EVIDENTLY FEEL THEIR WAY

Undisturbed blindfishes observed in caves are generally seen just above the bottom of the stream or lake moving about by means of slow oarlike strokes of the pectoral fins. One lazy stroke is followed by a long glide until the momentum is dissipated, and then another stroke follows. They usually come to rest in contact with the stream-bottom or a boulder. When they collide with a boulder or other object it is usually without much force.

If a strong flashlight beam is held on the fishes they slowly move away, but they do not pay attention to a weaker diffuse light. Sometimes they are alarmed and retreat to a hiding place if someone wades in the water near them. They are also greatly disturbed by the slow approach of a dipnet and, if closely approached or touched, they use their tail fins to dart wildly away toward the surface or under a rock. Occasionally they escape by hiding in a cloud of muddy water. Although they frequently collide with rocks or gravel shoals they seem to know their neighborhood and the collisions may be deliberate—perhaps they ascertain their location by thus "feeling" their way. They do not move incessantly, as does the Mexican blind tetra, but usually remain quietly resting with their tails drooping in order to maintain contact with the bottom. This more or less continuous contact with the solid parts of their home-range must be necessary to prevent their being carried away and "lost." During our cave collecting, if we missed capturing a fish we had only to return to the same locality later—sometimes several days later—and there would be our fish resting against the same rock as when we first observed it.

It has been demonstrated that the skin of blindfishes is sensitive to light and small temperature differences. Head, body, and even the tail fin have many short rows of very sensitive dermal papillae each with a



SMALL BLINDFISH FROM SOUTHERN TENNESSEE

Tubes of the creature's nostrils protrude like horns. Rows of sensory papillae visible on the side of the head. Some pigment developed in this white fish after it had been kept in the light for one month.

tigation since they first received public attention and description in the early 1840's. What were fishes doing in rivers deep in the earth far from any surface connection? How did they sustain life so far removed from the necessary source of all life, the sun? Why had they entered caves? Which surface fishes were their relatives? Why had their eyes degenerated? How did they find their way about from cave to cave and how did they locate food? Some of these questions were readily answered by simple observation. The answers to others are still largely incomplete, chiefly because no sustained investigation has been made of the habits and habitat of blindfishes.

Sixteen kinds of completely blind, exclusively subterranean fishes have been discovered in the underground freshwaters of the world. They belong to eight different families largely composed of normal-eyed fishes with one or two species of each family living in total darkness and without eyes. Most blindfishes are restricted to a fairly small area or to a particular limestone formation or cave system.

In North America two kinds of blind **catfishes** come from the artesian wells in Texas. Two kinds of blind **brotulas** are known from the subterranean freshwaters of Cuba and one from Yucatan. These are especially interesting because all other members of the brotula family live in the ocean. Another kind well-known to aquarists is the **cave tetra** from San Luis Potosi, Mexico. This species reveals a four-step gradation in the degeneration of the eyes from perfectly eyed, normally pigmented, surface-dwelling individuals to

waters of the Mississippi Valley, particularly in the unglaciated parts of Indiana, Kentucky, Tennessee, Missouri, northern Arkansas, and northern Alabama. These fishes are all fairly closely related, belonging to one very distinct family, the Amblyopsidae. The **big blindfish** lives only in the Mammoth Cave area and in south-central Indiana. **Rosa's blindfish**, its nearest relative, lives in southwestern Missouri and northwestern Arkansas. The **small blindfish**, widely distributed in Kentucky, Tennessee, Alabama, and south-central Missouri, superficially resembles the other two blindfishes but actually is more closely related to the only eyed members of the cave-fish family—the slightly pigmented **Agassiz' springfish** (which lives in caves, wells, mouths of springs, or even in surface streams under rocks) and the **rice fish** (which lives in blackwater swamps and in the shady sluggish parts of streams of the coastal plains from Virginia to south-central Georgia).

Superficially all three of these species of blindfish have the same appearance. When alive, the fishes are translucent white, with a flush of pink around the gills. When dead or preserved, they are pure opaque white. The head is flattened on top, snout broadly rounded, and body heavy near the head, tapering to quite thin near the tail. All the fins are broad and rounded (two of the three kinds do not have a set of paired ventral fins). The vent is not in its normal position but has migrated as far forward as it can to a position under the gill openings.

Blindfish are not the sole inhabitants of the Mississippi Valley caves. They live in



nerve fiber exposed at its tip. The eyed species of this family also are well equipped with these organs and probably rely more on them than on their eyes for information about their surroundings.

Fishes of the eternal dark are blind, but they certainly are not oblivious to their surroundings nor do they fumblingly grope their way about as do blinded surface animals. Their senses of touch, taste, and smell, though perhaps limited to their immediate surroundings, are so highly developed that these fishes do not appear to need sight, the sense on which the Primates are so dependent and for which an additional element, light, is needed.

#### INSENSITIVE TO SOUND

Blindfishes do not appear to be sensitive to sound, however. We could clatter our equipment or talk in loud voices without disturbing them. Some of these fishes that we kept in an aquarium would start violently

pouring from wall or roof. This noise is amplified by being echoed and re-echoed through the cave, and sometimes it was necessary for us to shout in order to carry on conversation above the noise that to us sounded like several people talking at once just around the corner. Such noise loses little intensity on transmission through water or from air to water.

Cave fishes are not gregarious but more or less solitary, and they pay little attention to other fishes as they move about. When several were seen fairly close together, presumably in a good locality for feeding, their position and their movements were independent, never grouped. The one exception was in a lake where we saw an unusually large fish followed by a close school of twelve to fifteen tiny fish, presumably its young.

The most favorable conditions for cave fishes appear to be reaches along the stream comparable to long, deep, quiet pools of

rocks and bars and even moved into water an inch or so in depth at the edge of the stream to avoid the current.

The most favorable type of habitat, judging from the hundreds of blind fishes seen in it, was an underground lake, 25 to 75 feet broad, with water 3 to 4 feet deep and a bottom of soft silt 1 to 2 feet in thickness. A stretch 400 yards long of this lake was examined by four slowly stalking men, and more than a thousand fish were seen scattered over the bottom. Also in this place the largest individuals of the **small blindfish** were observed to be almost equal in size to average individuals of the **big blindfish**.

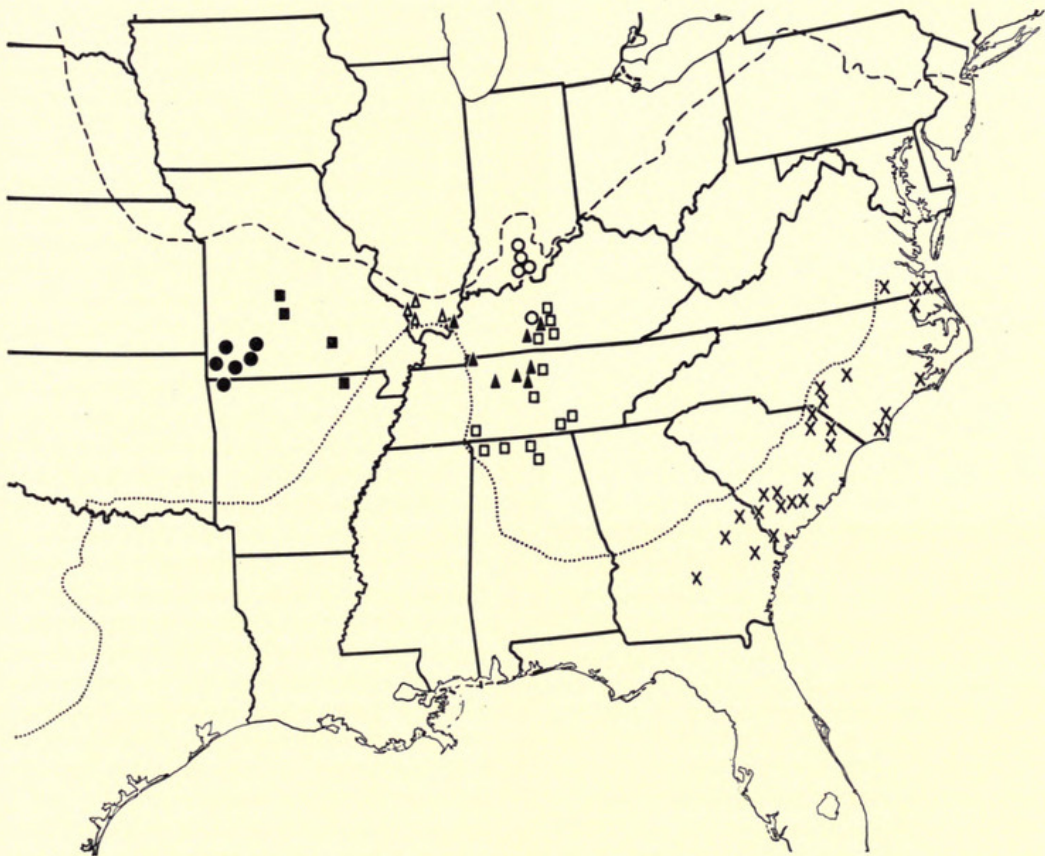
#### SEEM TO BE HARDY

All cave fishes we have collected were fat and appeared to be in excellent condition. They store fat between the lengthwise muscle layers along the midline of the back, along the midline of the sides, and also in the tissues surrounding the viscera. Very likely they normally survive fairly long periods of starvation and remain in good condition. We have kept them for three months in an aquarium where they refused all food and were not noticeably thinner at the end of this time. They have been kept for as long as nine months, during which time they never ate. All are known to be carnivorous. The majority of stomachs examined were empty but a few contained crayfish and sow bugs. Although we have observed the fishes for several hours in the caves, we never saw one feeding.

The egg-laying or spawning behavior of the amblyopsids has never been observed but it is known that in one species, the **big blindfish**, the eggs are carried in the gill chamber of the female and the newly hatched young are incubated there also. Probably the young stay in the gill chamber until they are able to swim and follow the parent. There are no observations on young re-entering the brooding chamber once they have left it. It has been reported that 60 to 70 eggs are laid by the female into her gill chamber, where they remain for about two months. The opening of the oviduct is located far forward in this group of fishes in a position just under the gill openings.

Fishes with ripe eggs in the ovary or with eggs or larvae being incubated have been taken from Indiana caves during various times from March to November. It is quite likely that they spawn throughout the year. Although only this bare outline of the reproductive habits of the **big blindfish** is known, the displacement of the oviduct opening and the enlarged gill chamber with reduced gills also occur in the other species of this family and indicate that they have similar habits of caring for their eggs and young.

(To be continued in the next issue)



DISTRIBUTION OF CAVE FISH FAMILY IN EASTERN U.S.

Dashed line marks southern limit of glacial drift; dotted line, the Mississippi Embayment, a Cretaceous encroachment of the sea. The x's indicate the range of the ricefish, and the triangle symbols denote that of the springfish (both of these species are eyed.) The square symbols trace the range of the small blindfish; outline circles, the large blindfish, and solid black circles, Rosa's blindfish.

if we suddenly rapped hard on the table on which the aquarium rested. This reaction to strong low-frequency vibrations probably was sensed as much by touch as by sound. The auditory apparatus is normally developed in these fishes, and they probably can hear as well as most other fishes but are just indifferent to sound. While some caves are absolutely quiet, others are very noisy from water dripping or small springs

surface streams. They were most often found where the water was fairly deep (2 feet or more) and where the bottom was thickly covered with a layer of fine silt. They seemed to congregate around rocks that cropped out through the silt. In a few caves solitary individuals were living in shallow streams with a rocky or gravel bottom and a fair current. In such places the fish took advantage of every sheltering eddy behind





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