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Status Review of the Threatened Ozark Cavefish (Amblyopsis rosae)

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tions made from April through June. A second species, *R. fenestra* Ross was collected twice north of Batesville during May of 1986. Ross (1944) described this species from Ozarkian region of southern Illinois and stated that it was only known in Illinois.

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STATUS REVIEW OF THE THREATENED OZARK CAVEFISH *(Amblyopsis rosae)*

The Ozark cavefish, *Amblyopsis rosae* (Eigenmann), is a small, white, blind fish that is specially adapted for living in Ozark Highlands cave ecosystems. It is one of the most cave-adapted vertebrates known (Poulson, Amer. Midl. Natur., 70[2]:257-290, 1963). This degree of specialization, which includes limited reproductive effort, severely restricts its ability to recover from even moderate population declines.

The range of *A. rosae* is limited to limestone solution caverns in the Springfield Plateau of Arkansas, Oklahoma, and Missouri. After searching 180 potential habitat sites during the period 1980-1983, Willis and Brown (Amer. Midl. Natur., 114:311-317, 1985) reported having seen cavefish in five caves in Missouri, four in Arkansas, and three in Oklahoma. Sightings by others during this period added locations in Missouri (Fantastic Caverns) and Oklahoma (Cave Springs Ranch Cave).

Historically the Ozark cavefish occurred in at least 24 caves in nine counties. Unconfirmed reports would extend its previous occurrence to 52 caves in 14 counties. The report by Willis and Brown (Amer. Midl. Natur., 114:311-317, 1985) of demes in 14 caves in six counties indicated substantial losses of former range, particularly in southwestern Missouri.

Destruction of cave habitat is the primary cause of the decline of cavefish populations, although collecting, disturbance by spelunkers, and limited reproduction are also responsible. Several caves which formerly contained Ozark cavefish have been sealed shut by landowners, flooded by reservoirs, or dried up by lowered water tables (Willis, M.S. Thesis, University of Arkansas, Fayetteville, AR, 1984). Optimum cavefish habitat consists of caves occupied by large colonies of gray bats *(Myotis grisescens)*. Of the 14 cave habitats reported by Willis and Brown (Amer. Midl. Natur., 114:311-317, 1985) to contain fish, five still contain bat colonies, while six others contain guano from past use by bats. Therefore *A. rosae* appears to be dependent on a species which is itself endangered.

This study was initiated to review the status of the Ozark cavefish by checking the previously-known populations and searching for additional ones. Caves were searched using bright lights by two people (three in Caves Springs Cave, Benton County, Arkansas) moving slowly upstream counting cavefish as they were encountered. In larger pools, the surveys were continued using facemasks and snorkels. Efforts were taken to minimize

Location and Cave Name	1980-1983 survey: no. of visits	1980-1983 survey: max. no. of cavefish	1985-1987 survey: no. of visits	1985-1987 survey: max. no. of cavefish
Arkansas, Benton Co.				
Cave Springs Cave	5	100	1	122
Logan Cave	10	12	2	32
Mule Hole Sink	3	4	2	0
Civil War Cave	5	4	1	5
Rootville Cave	4	0	1	1
Nursery Pond	0	0	6	5
James Ditto Cave	0	0	3	2
Bear Hollow	4	0	6	0
Dickerson Cave	1	0	3	0
Leslie Cave	1	0	1	0
Hickory Creek	1	0	2	0
Arkansas, Washington Co.				
Mineral Springs	1	0	1	0
Zero Mountain	0	0	1	0
Oklahoma, Delaware Co.				
Twin Cave	6	5	4	3
Jail Cave	7	3	3	3
Engelbrecht Cave	2	1	1	0
Engelbrecht Spring	0	0	1	0
Mitchell #1,2,3	2	0	1	0
Mitchell New Sink	0	0	1	0
January-Stansbury	2	0	2	0
Missouri, Green Co.				
Fantastic Caverns	7	2	3	0
New Sink	0	0	1	0
Missouri, Jasper Co.				
Sarcoxie Cave	2	3	0	0
Kellhaufer's Cave	1	4	1	4
Wilson's Cave	6	4	1	0
Missouri, Lawrence Co.				
Turnback Creek Cave	5	1	3	1
Missouri, Newton Co.				
Ben Lassiter Cave	6	4	3	2
Elm Spring	1	0	3	0
Missouri, McDonald Co.				
Henson Cave	1	0	3	0

Table 1. Status of Ozark cavefish in the Springfield Plateau during 1980-1983 and during 1986

disturbance to the cave system. Searches were discontinued from March 15 through September 15 in caves known to contain gray bats, and at other times when endangered bats were seen.

Of the 14 caves reported by Willis and Brown (Amer. Midl. Natur., 114:311-317, 1985) to contain cavefish, fish were sighted in eight (Table 1). These were Logan Cave, Cave Springs Cave, and Civil War Cave in Arkansas; Ben Lassiter Cave, Turnback Creek Cave, and Kellhaufer's Cave in Missouri; and Twin Cave and Jail Cave in Oklahoma. However, two of the caves could not be adequately surveyed. Sarcoxie Cave and Kellhaufer's Cave, Jasper County, Missouri, were flooded by heavy rains. The owners of Kellhaufer's Cave reported seeing four fish in the cave June 30, 1986. Failure to sight fish in Fantastic Caverns in three visits is significant because a large area can be searched during each visit.

Three new Ozark cavefish populations were found in Benton County, Arkansas. A single fish was observed in Rootville Cave January 17, 1986. Henry James and Scott Ditto, amateur cavers, excavated a narrow passageway into a small cave near Gentry, Arkansas. Our visits to the cave on January 29, 1987 confirmed their reports of an *A. rosae* population. An unintentional excavation of a water-filled cave on the east bank of Beaver Reservoir by Arkansas Game and Fish Commission personnel revealed the third additional location for Ozark cavefish in Arkansas.

During the 1983 survey (Willis and Brown, Amer. Midl. Natur., 114:311-317, 1985), Mule Hole Sink, Benton Co., Arkansas, contained a small pool at the bottom which contained cavefish. During the present study the pool did not exist. Mule Hole Sink is probably connected to Cave Springs Cave which is 2 kilometers to the south, and has easier access. Wilson's Cave in Jasper County, Missouri, consists of only a small pool in the twilight zone that is accessible to humans. During this study the pool contained several bluegill *(Lepomis macrochirus)* and a large snapping turtle *(Chelydra serpentina)*. Presence of these predators probably is related to lack of sightings of cavefish at this location.

The larger number of fish seen in Logan Cave in 1986 (Table 1) was probably due to use of facemasks and snorkels in the larger pools. Many of the fish could not have been seen from the surface because of their position beneath undercut areas of the cave walls. Apparently, greater numbers of fish can be seen in the caves between December and March compared with other times of the year.

Many of the caves continue to be abused by frequent visits by cavers, as evidenced by debris left in the caves, writing on the walls, etc. Strict limitation of this traffic must be achieved to ensure continued survival of this interesting species.

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THE EFFECT OF CITY EFFLUENT ON THE DIVERSITY OF AQUATIC MACROINVERTEBRATES OF SUGAR CREEK, CLAY COUNTY, ARKANSAS

Sugar Creek is a small stream that originates on Crowley's Ridge in Clay County, Arkansas. It flows through Piggott and receives surface runoff from the community. South of Piggott, it has been channelized and drains into Big Slough Ditch, within the St. Francis River watershed. The purpose of the study was to determine what effect, if any, the surface runoff from Piggott had on the aquatic macroinvertebrate community of Sugar Creek.

Only three previous studies have been published with respect to biota of streams on Crowley's Ridge. Cather and Harp (1975) compared the aquatic macroinvertebrates of an Ozark stream to those of a deltaic stream that originates on Crowley's Ridge in Greene County, approximately 60 km southeast of this study area. Beadles (1970) noted effluent effects on fishes of Lost Creek, and Fulmer and Harp (1977) surveyed the fishes of streams occurring on the Ridge, three of which are in Clay County.

Sugar Creek is a second order stream within the study area. The main channel has a mean width of approximately 12 m and a maximum depth of 3 m at flood stage. The stream has a substrate of sand, gravel, silt and organic mud and the banks are steep and often eroded. Vegetation along the banks includes oak, willow, elm, hickory, sycamore, sweet gum, hackberry and tulip poplar. The soil type in the northern part of the study area is Collins silt loam. This loam is moderately well drained and found on upland drainageways and level areas next to Crowley's Ridge. Falaya silt loam was found south of Piggott along the creek. This loam is poorly drained and found on the flood plains of upland drainageways and level areas near the Ridge. Both soil types are primarily a mixture of brown silt loam and mottled brown silt loam. Both are low in organic matter and strongly acid. They are often geographically associated (Soil Conservation Service, 1978).

For collection purposes, two stations were established on Sugar Creek. Station I was located at the northern edge of the city limits in the SE¼ S3, T20N, R8E. Station II was located downstream, at the southern city limits, in the SW¼ S11, T20N, R8E. Collections were made for a timed period of 45 minutes from each station every two weeks from 31 August-9 November 1985. Collections were made with a fine mesh aquatic "D" net. An attempt was made to sample all microhabitats. Specimens were preserved in 70% ethanol. After identification, all specimens were catalogued and housed in the Aquatic Macroinvertebrate Collection of the Arkansas State University Museum of Zoology (ASUMZ).

Simpson Diversity, Simpson Dominance, Shannon-Wiener Diversity, H'max and Evenness values were calculated using the AQUATIC ECOLOGY-PC disc of Oakleaf Systems, Decorah, IA. Simpson's Index of Diversity corresponds to the number of randomly selected pairs of individuals that must be drawn from a community in order to have an even chance of obtaining a pair with both individuals of the same species. It therefore expresses the dominance of or concentration of abundance into the one or two commonest species of the community (Poole, 1974). Conversely, the Shannon-Wiener Diversity Index expresses the relative eveness of the abundances of all the species. Further, it is relatively independent of sample size (Poole, 1974). H'max is a calculated theoretical maximum diversity (Wilhm and Dorris, 1968). The base 2 logarithm was selected for calculating diversity indices, as it is the most commonly utilized log (Cox, 1985).

A total of 927 specimens of aquatic macroinvertebrates was collected (Table 1). Station I showed the greatest species richness with 44 taxa, 24 of which were found only at Station I. Station II had 24 taxa, with four taxa found only at that station. Stations I and II had 20 taxa in common. Of the 44 taxa collected, 42 were generalists, or species found in many different habitats. Two exceptions to this were *Hydrometra hungerfordi*, a rarely collected species that prefers clean water streams (Harp, 1985), and *Calopteryx maculata*, which is characteristically found in small shaded streams in forested areas (Walker, 1953). These two species were collected at Station I.