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# LONGITUDINAL DISTRIBUTION OF THE FISHES OF THE BUFFALO RIVER IN NORTHWESTERN ARKANSAS,

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## ABSTRACT

A survey of the fishes of the Buffalo River in northwestern Arkansas was conducted over a seven year period. The Buffalo is a free-flowing tributary to the cold tailwater section of the White River below Bull Shoals Dam, and is wholly contained in the Ozark Upland province.

Fifty-nine species were recorded for the river based on 135 collections and literature records. Relatively continuous distribution was shown for 38 species. The general pattern of distribution for the river was one of species addition rather than replacement from headwaters to the mouth.

## INTRODUCTION

The Buffalo River in northwestern Arkansas is a wild, free-flowing, Ozark Upland stream. The river courses approximately 135 miles from its headwaters in the Boston Mountains to its confluence with the White River, 27 miles below Bull Shoals Dam.

In 1963 the National Park Service recommended that this last unimpounded stream in the Arkansas Ozarks be designated a National River (Smith, 1963). Very different plans by the U.S. Army Corps of Engineers called for the construction of a dam at Gilbert, Searcy County, which would inundate 50 miles of stream (Smith, 1963). Through the efforts of concerned naturalists, dam construction has been averted and the Buffalo River's scenic beauty has been preserved. In 1972 the 92nd Congress approved the establishment of the Buffalo River as a National River, and a temporary office of the National Park Service was established in Harrison, Arkansas to purchase the necessary land (Mr. Joe Clark, pers. comm.).

The present study originally began as a pre-impoundment survey of the fishes of the Buffalo River. The construction of large hydro-electric dams is known to alter the faunal composition not only within reservoirs, but in tailwaters as well (Moffett, 1942; Summers, 1954; and Pfitzer, 1962). Thus such a study seemed timely. Fortunately, this paper will now serve as a record of the species present and their longitudinal distributions within the Buffalo River, a protected river.

## METHODS

Sixteen stations were established on the Buffalo River and its tributary streams between the headwaters and the mouth (Fig. 1). These stations were sampled from one to six times during the summers of 1965 and 1966. The lowermost localities (Stations 1 and 2), at the mouth and 2.0 miles above the mouth, were sampled monthly from October, 1965 to October, 1966. Supplemental collections were made by the senior author from the fall of 1968 to the spring of 1972. A total of 135 collections was made during this study. Over 24,000 specimens were collected using a 115 volt, 1,000 watt AC shocker, and a 10 foot, 3/16 inch mesh nylon seine. Localities in the middle and lower sections of the river were often reached by boat, and much of the electro-shocking was done from the boat. The points on the map indicate the sites where collecting began, or where the boat was launched. When possible, we electro-shocked one or two miles up and downstream from the starting point. Station 3 was a general survey site that covered nearly 5 river miles and was reached by motoring upstream from the mouth. Most of the specimens collected were deposited in the Tulane University Fish Collection.

Three additional stations were designated from collections made by other workers. Station 4, Buffalo River at the mouth of Brush Creek, was sampled by Dr. Kirk Strawn and students from the University of Arkansas in the summer of 1963. Dr. Neil Douglas and Mr. Terry Guidroz, Northeast Louisiana State University, made three collections in the winter of 1972 and the spring of 1973 at Station 11, Buffalo River 5.0 miles northeast of Snowball, Searcy County. The extreme headwater site (Station 19) was based on records by Dr. J.D. Black (1940). Literature records and other collections from the Buffalo River housed at Tulane University (TU) and Northeast Louisiana State University (NLU) were used to determine longitudinal distributions for many species (Table 1).

*List of localities and approximate river mileages from the mouth:*

1. Mouth of Buffalo River to 0.5 mile upstream, Baxter-Marion counties.
2. Buffalo River about river mile 2, Baxter-Marion counties.
3. Buffalo River, general survey area, river mile 3-8, Marion County.
4. Buffalo River, at the mouth of Brush Creek, river mile 14.6, Marion County, (Strawn and party, 1963).
5. Buffalo River, at the mouth of Clabber Creek, river mile 22, Marion County.
6. Buffalo River, at the town of Rush, river mile 24, Marion County.
7. Rush Creek, at the town of Rush, 0.5 mile above its confluence with the Buffalo River, Marion County.
8. Buffalo River, from State Hwy. 14 crossing to State Park, river mile 28-30, Marion County.
9. Bear Creek, at U.S. Hwy. 65 crossing, about 10 miles above its confluence with the Buffalo River (approximately mile 54), Searcy County.
10. Buffalo River, at Gilbert and U.S. Hwy. 65 crossing, river mile 49, Searcy County.
11. Buffalo River, 5.0 miles northwest of Snowball on County Rd. 377, river mile 65, Searcy County, (Douglas and Guidroz collection, 1973).
12. Richland Creek, near Eula on County Rd. 377, about 4 miles above its confluence with the Buffalo River, Searcy County.
13. Buffalo River, 2.0 miles south of Hasty on State Hwy. 74, about river mile 78, Newton County.
14. Little Buffalo River, at Jasper on State Hwy. 74, 5 miles above confluence with Buffalo River, Newton County.
15. Little Buffalo River, near Parthenon on County Rd. 327, 11 miles above its confluence with the Buffalo River, Newton County.
16. Buffalo River, near Pruitt on State Hwy. 7, about river mile 88, Newton County.
17. Buffalo River, 0.5 mile east of Ponca on State Hwy. 74, about river mile 107, Newton County.
18. Unnamed Creek, one mile south of Ponca on State Hwy. 43, about river mile 108, Newton County.
19. Buffalo River, approximately 4 miles southwest of Mossville, about river mile 120, Newton County (Black, 1940).

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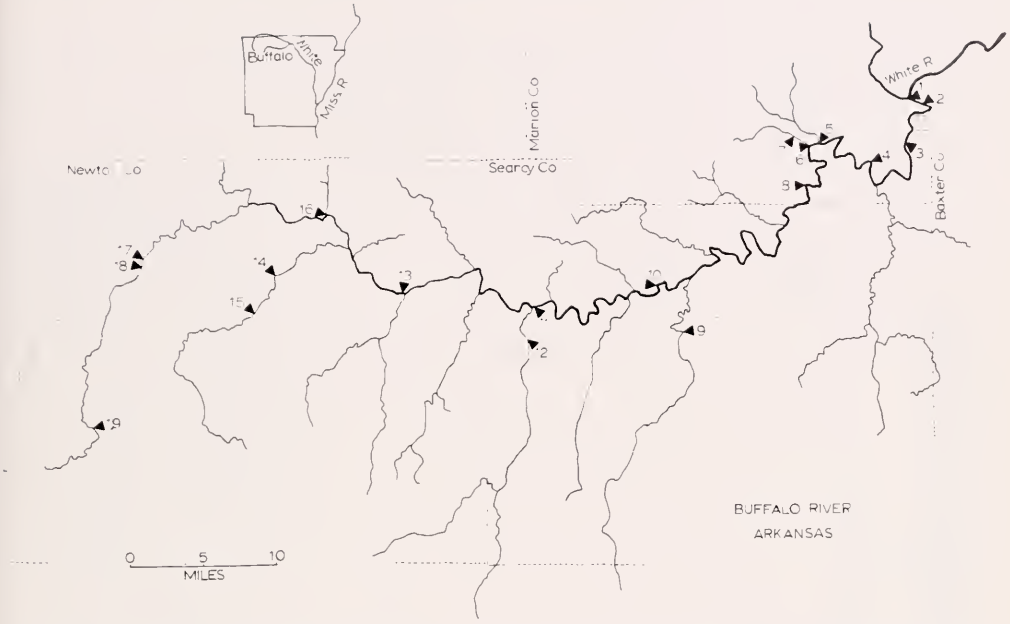


FIGURE 1. Map of the Buffalo River in Northwestern Arkansas, with Collecting Sites.

field during the early part of this study. Special thanks go to Bruce A. Thompson and Julian M. Humphries for aiding the senior author on additional collecting trips from 1968 to 1972.

Thomas M. Buchanan, Neil H. Douglas, and Terry Guidroz kindly provided information concerning collections made in the Buffalo River drainage during 1972 and 1973. Royal D. Suttkus, Tulane University (TU), Neil H. Douglas, Northeast Louisiana University (NLU), and Reeve M. Bailey and Robert R. Miller, University of Michigan Museum of Zoology (UMMZ), kindly allowed us to examine specimens under their care.

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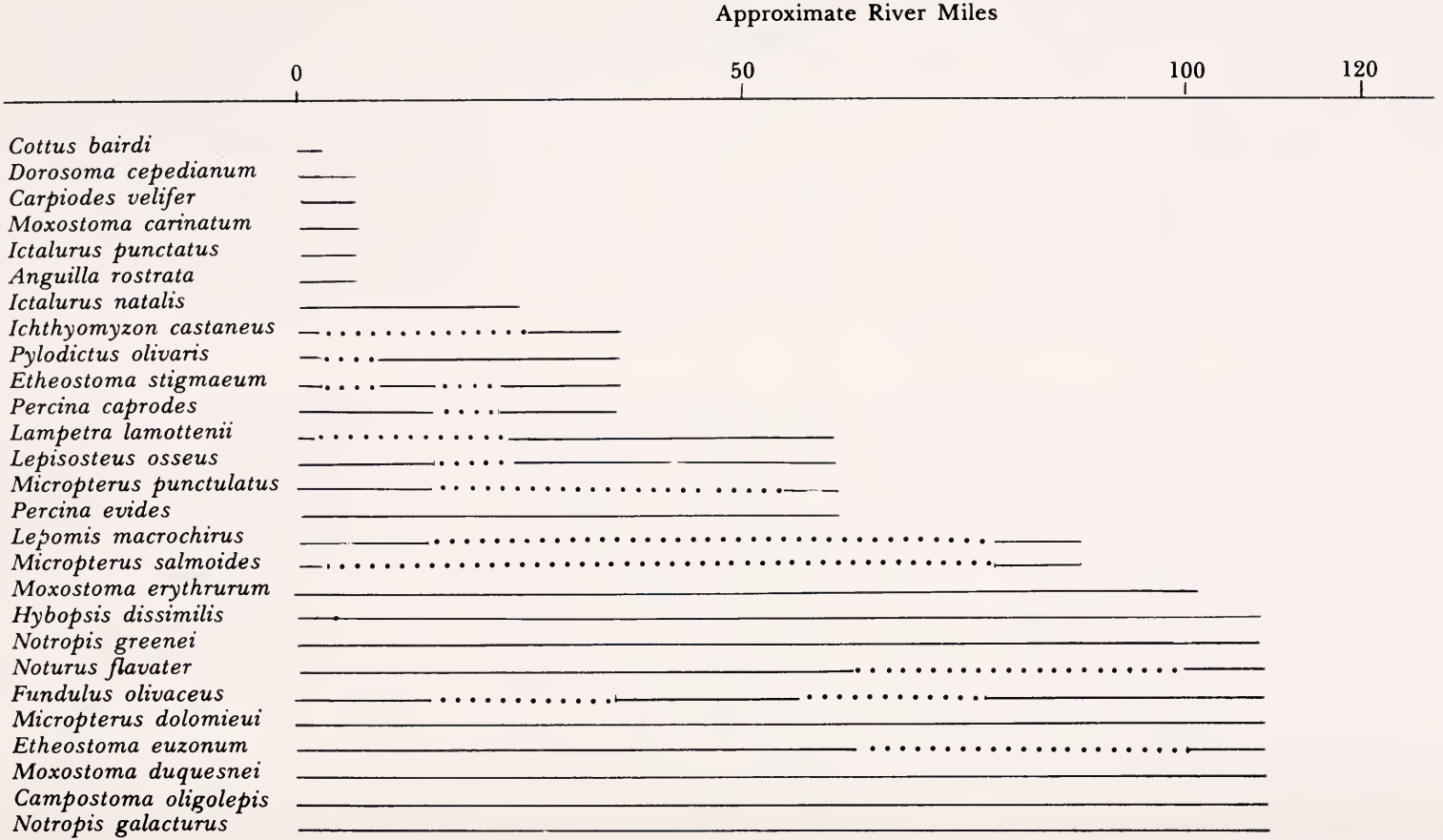
## DESCRIPTION OF THE STUDY AREA

The Buffalo River drains an area of 1383 sq. mi. and has an average rate of fall of 5.23 ft/mi (Gladson, 1911). The substrate is primarily gravel and rubble, with some boulders in the headwater section (sites 14-19). In the middle and lower sections, rubble, boulder, and bedrock are the more common bottom types, but there are extensive gravel riffle areas in these regions as well. There is a detectable deposit of silt in the lower reaches where the Buffalo River has its confluence with the White River.

In the summer the flow of the Buffalo River from above Ponca (Site 17) to Gilbert (Site 10) was intermittent. The river in this region consisted of a series of deep pools connected by the very shallow flow of the main channel in the summers

Table 1. Longitudinal distribution of fishes in the Buffalo River, Arkansas. Line is continuous if a species was not missing from two or more successive localities, otherwise the line is dotted.



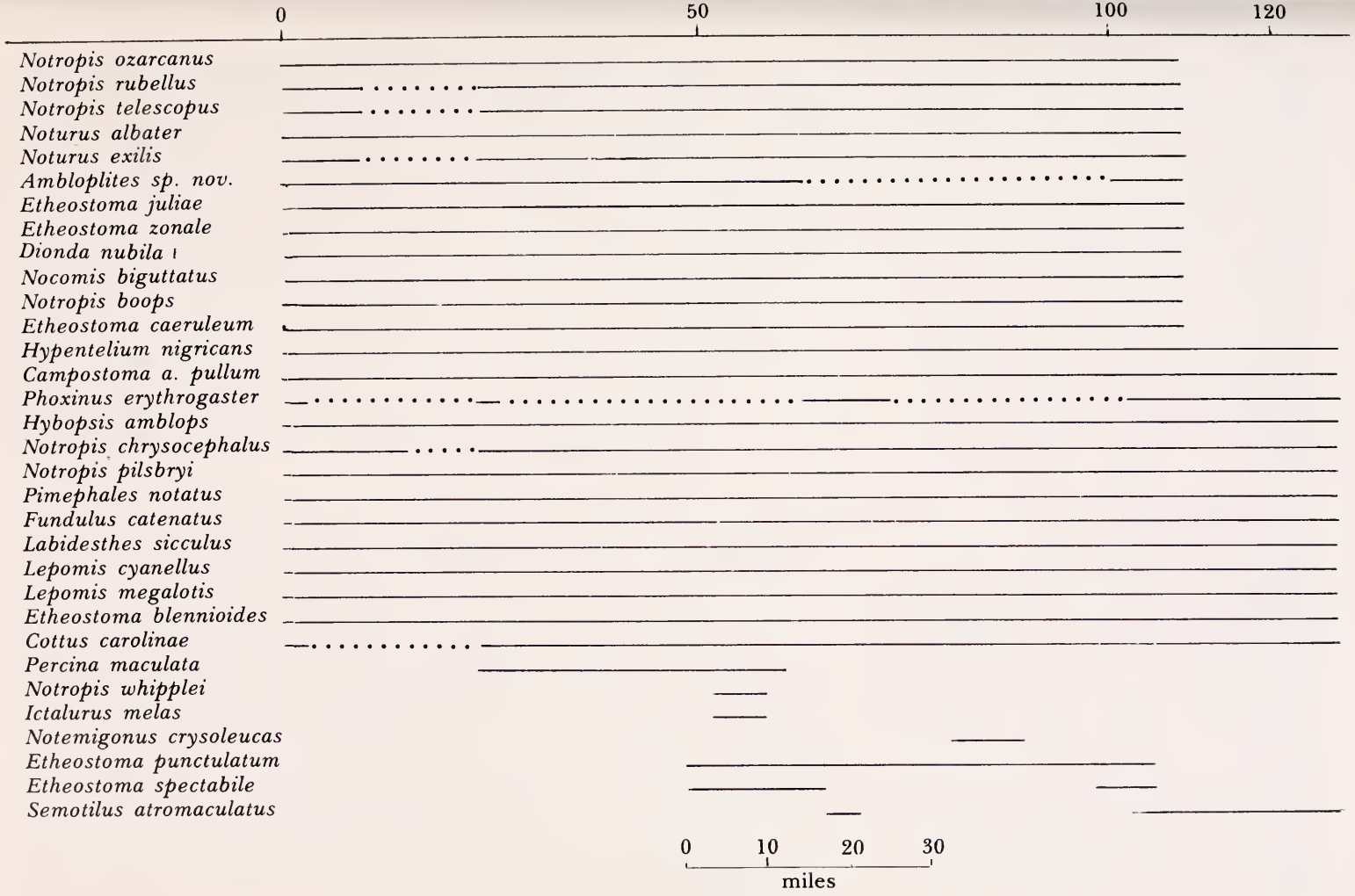

0
50
100
120
Notropis ozarcanus
Notropis rubellus
Notropis telescopus
Noturus albater
Noturus exilis
Ambloplites sp. nov.
Etheostoma juliae
Etheostoma zonale
Dionda nubila
Nocomis biguttatus
Notropis boops
Etheostoma caeruleum
Hypentelium nigricans
Campostoma a. pullum
Phoxinus erythrogaster
Hybopsis amblops
Notropis chrysocephalus
Notropis pilsbryi
Pimephales notatus
Fundulus catenatus
Labidesthes sicculus
Lepomis cyanellus
Lepomis megalotis
Etheostoma blennioides
Cottus carolinae
Percina maculata
Notropis whipplei
Ictalurus melas
Notemigonus crysoleucas
Etheostoma punctulatum
Etheostoma spectabile
Semotilus atromaculatus
0
10
20
30
miles

Table 2. Mean discharge (CFS) for the Buffalo River at two stations during the summers of 1965 and 1966. U.S. Geological Survey (1965 and 1966).

| | June | | July | | August | | Calendar Year | |
|---|---|---|---|---|---|---|---|---|
| Station | 1965 | 1966 | 1965 | 1966 | 1965 | 1966 | Oct. 1964 to Sept. 1965 | Oct. 1965 to Sept. 1966 |
| Buffalo R. at Rush | 566 | 115 | 305 | 43.3 | 66.8 | 39.8 | 541 | 637 |
| Buffalo R. near St. Joe | 665 | 163 | 375 | 74.4 | 99.2 | 63.8 | 695 | 761 |

of 1965 and 1966.

Farther downstream the flow is more regular. Data gathered by the U.S. Geological Survey during the summer months at Buffalo River stations near St. Joe (Site 10) and Rush (Site 6) are presented in Table 2.

Summer water temperatures in the upper section of the Buffalo River ranged from 25 to 28°C. Downstream water temperatures were higher (28 to 31°C). The Buffalo River is a southwestern tributary of the cold tailwater section of the White River below Bull Shoals Dam. In this section of the White River water temperatures may be as low as 7°C at any time of the year (Brown *et al.*, 1967). During summer months a sharp temperature differential exists between waters of the main channel and the side of the White River receiving the comparatively warm waters of the Buffalo River. This difference in temperature persists over seven miles downstream, where another cold tailwater, the Norfolk River, enters from the north. The water temperatures in the southern side of the White River channel, below the confluence of the Buffalo River, ranged from 22 to 28°C in the summers of 1965 and 1966. During the same time the northern part of the main channel had water temperatures ranging from 11.5 to 24°C.

## RESULTS AND DISCUSSION

### *Distribution of Fishes in the Buffalo River*

Black (1940) recorded 26 species from the Buffalo River at six localities from the extreme headwaters, near Mossville in Newton County, to near Gilbert in Searcy County (about river mile 49). All but one of those species, the steelcolor shiner, *Notropis whipplei*, were collected during our study. Fifty-six species, representing 12 families, were collected during our survey.

During the summers of 1965 and 1966, and on subsequent visits to localities in the headwaters sections above Ponca and Parthenon (Stations 15 and 17), the flow of the Buffalo and Little Buffalo branches was found to be intermittent. Black (1940), however, reported 14 species from the headwaters of the Buffalo near Mossville (Station 19). The creek chub, *Semotilus atromaculatus*, was the only one of these not found to occur throughout the length of the river to its confluence with the White River, a distance of over 130 miles. Collections made during our study in the upper section of the river (Stations 14-18), yielded 38 species of fishes, including seventeen cyprinid species. Thirty-five of those species were also taken in

collections throughout the river down to the mouth. Four of the 38, the southern redbelly dace, *Phoxinus erythrogaster*, the creek chub, *S. atromaculatus*, the strippled darter, *Etheostoma punctulatum*, and the orangethroat darter, *E. spectabile*, appeared to be restricted to the headwaters or to small, springfed tributaries to the main river. The occurrence of these species in the main channel was usually associated with the mouth of a small stream. The central stoneroller, *Campostoma anomalum pullum*, was most frequently encountered in such habitats. It was also found, however, throughout the main river, occurring syntopically with the largescale stoneroller, *C. oligolepis*.

Twenty-three of the 56 species collected during our study were taken at all, or all but one, of the 18 sites. Six additional species, the striped shiner, *Notropis chrysocephalus*, the rosyface shiner, *N. rubellus*, the telescope shiner, *N. telescopus*, the slender madtom, *Noturus exilis*, the blackspotted topminnow, *Fundulus olivaceus*, and the banded sculpin, *Cottus carolinae*, presumably exhibit an equally continuous distribution pattern, but were missing from at least two or more successive localities. The hiatus in their distribution can be more satisfactorily explained as due to inadequate collecting, rather than as representative of any true break in the longitudinal distribution of these species.

Six species were found only in the lower reaches of the Buffalo River (Stations 1-4). These were the gizzard shad, *Dorosoma cepedianum*, the highfin carpsucker, *Carpiodes velifer*, the river redhorse, *Moxostoma carinatum*, the channel catfish, *Ictalurus punctatus*, the American eel, *Anguilla rostrata*, and the mottled sculpin, *Cottus bairdi*. Probably only the mottled sculpin is truly restricted to this region. Monthly collections from sites farther upstream would almost certainly include young or seasonally migrating adults of the other five species.

The overall distribution pattern of the Buffalo River fishes appears to be one of species addition, rather than species replacement. Faunal diversity increased rather rapidly from the uppermost site of Black (Station 19), with 14 species, to sites further downstream, where streamflow was uninterrupted and the river channel was noticeably larger, with 38 species. Faunal additions occurred more slowly, but regularly, for the next 56 miles (Stations 13-5), with 12 new species taken to raise the total to fifty. The most diversity was encountered in a very short section of the river, from river mile 8 to the mouth. In this region, 52 species were collected, and six additions were made to the species total.

Five species occurring in the cold tailwaters of the White River, above its confluence with the Buffalo River, may be present in the Buffalo River as well. Two, *Salmo gairdneri*, the rainbow trout, and *S. trutta*, the brown trout, are introduced. The threadfin shad, *D. petenense*, has been successfull stocked in Bull Shoals reservoir (Pflieger, 1971), and appeared in a few collections made below the dam in 1965. *Pimephales promelas*, the fathead minnow, has been used as a bait species throughout the Ozarks (Pflieger, 1971), and two specimens were taken in the White River near Cotter, Arkansas, in 1965. On one occasion, a black crappie, *Pomoxis nigromaculatus*, was collected by electroshocking in a backwater pool off the main White River, within 250 yards of the mouth of the Buffalo River. In addition, the steelcolor shiner, *Notropis whipplei*, has been reported from the Buffalo River near Gilbert, Arkansas (Black, 1940; Gibbs, 1963), though no specimens were collected during the course of this study, and Neil Douglas (pers. comm.) has found a population of golden shiner, *Notemigonus crysoleucas*, in Big Creek, a tributary to the upper section of the Buffalo River. Buchanan (1973) reported *Percina maculata* from two localities bringing the confirmed species total for the Buffalo River to fifty-nine.

The Buffalo River is wholly contained within the Ozark Upland physiographic province. Changes in gradient, substrate, stream size, and other physical features are fairly gradual from headwaters to the mouth. Sharp breaks in the

physical features of the river are minimal. The pattern of species diversity and distribution is not unlike that reported for many other free-flowing, unpolluted streams (Sheldon, 1968; Hynes, 1970; Jenkins & Freeman, 1972).

*Selected Species Accounts*

As mentioned above, the pattern of distribution in the Buffalo River is generally one of species addition. However, in at least three cases, replacement of headwater species by related forms farther downstream was noted. These involved *Campostoma a. pullum* and *C. oligolepis*; *Etheostoma spectabile* and *E. caeruleum*; and *Cottus carolinae* and *C. bairdi*.

*Campostoma.*—The occurrence of the largescale stoneroller, *C. anomalum oligolepis* Hubbs and Green, together with the central stoneroller, *C. a. pullum* (Agassiz), was first reported in the White River system in Arkansas by Black (1940). More recently, Pflieger (1971) recognized *C. oligolepis* as a full species based on a number of morphometric and meristic characters. This has been confirmed by Burr and Smith (1976).

The distribution of the central and largescale stonerollers in the Buffalo River was very similar to that reported by Pflieger (1971) for stonerollers in Ozark streams in Missouri. Both species occurred in similar habitats, but *C. a. pullum* showed a distinct preference for smaller streams. In the headwaters and in the smaller tributary streams, the central stoneroller was more numerous, often to the exclusion of the largescale stoneroller. At two upstream sites, the Little Buffalo branch near Jasper (Station 14) and the Buffalo branch near Ponca (Station 17) the ratio of *C. a. pullum* to *C. oligolepis* was about 5 to 3. Downstream from the confluence of the two branches the proportion changed, with the largescale stoneroller outnumbering the central stoneroller by more than 2 to 1.

*Etheostoma.*—Almost total replacement occurred between the two closely related darter species of the subgenus *Oligocephalus*. The rainbow darter, *E. caeruleum*, is extremely abundant in riffles, over gravel and rubble substrates, in the larger streams of the White River system in the Ozark Uplands. During our survey in the summers of 1965 and 1966 in the main Buffalo River over 800 *E. caeruleum* were collected, but not one specimen of *E. spectabile* was taken. In the lower reaches of the river, where monthly collections were made for 14 months, nearly 2,000 specimens of rainbow darters were collected by electroshocking, but the orangethroat darter was absent. Literature records for *E. spectabile* in the Buffalo River drainage (Black, 1940; Hubbs and Strawn, 1957; and Distler, 1968) convinced us that the species was common and fairly widely distributed in the drainage. Collections by Douglas and Guidroz in a number of smaller tributary streams have yielded large series of *E. spectabile*, which we have examined.

*Cottus.*—The banded sculpin, *C. carolinae*, was distributed throughout the Buffalo River drainage almost continuously from headwaters to the mouth. It was the only species of sculpin collected by us from river mile 108 to mile 2, where it was often quite common. At the lower two stations, mile 2 and mile 0, the mottled sculpin, *C. bairdi*, greatly outnumbered *C. carolinae* (Table 3), and in the cold tailwaters of the White River, the mottled sculpin virtually replaced the banded sculpin (Brown *et al.*, 1967). Pflieger (1971) noted that the habitat requirements for the two species were very similar, but that *C. carolinae* tended to inhabit the larger, warmer Ozark streams, whereas *C. bairdi* preferred the smaller creeks and spring branches. Black (1940) reported that the White River was the most unchanged of all Arkansas streams. He also indicated that *C. carolinae* was by far the more common of the two species of sculpin in Ozark waters. From his account it appears that the banded sculpin was predominant in the upper White River and that it was the only sculpin collected in the Buffalo River. The construction of three large hydroelectric dams on the Upper White River has brought about numerous changes in the physical and chemical

Table 3. Station by station totals for *Cottus* in the Buffalo River for the summers of 1965 and 1966.

| | 18 | 17 | 16 | 14 | 13 | 12 | 10 | 9 | 8 | 6 | 5 | 3 | 2 | 1 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| *Cottus carolinae* | 2 | 17 | 5 | 65 | 0 | 0 | 0 | 376 | 0 | 4 | 0 | 0 | 7 | 5 |
| *Cottus bairdi* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 5 | 239 |

characters of the river. Quite likely, the severe alteration of water temperature of the tailwater section of the Upper White River has created extensive habitat for *C. bairdi*. Perhaps, in the winter months when the water temperatures of the Buffalo River were even colder than those of the White, the mottled sculpin entered the lower section of Buffalo and became well established there.

*Ambloplites.*—Pflieger (1971) noted the striking color pattern of Upper White River rockbass. The genus *Ambloplites* is currently being studied by the senior author, who regards the form as warranting specific recognition.

*Comparison with the White River*

The construction of a series of impoundments on the upper White River in northwestern Arkansas and southwestern Missouri has severely altered the physical and chemical conditions of the effluent. The normal distributions of many species of fish and aquatic invertebrates have likely been affected. Pre-impoundment data, as such, for the area now inundated by Bull Shoals reservoir are not available. However, the extent of the disruption may be inferred by reviewing studies on unimpounded sections of the upper White above Bull Shoals Dam.

Knapp (1958) and Keith (1964) reported 70 and 72 species of fish, respectively, in pre-impoundment studies in free-flowing sections of the upper White drainage in Arkansas and Missouri. Brown *et al.* (1967) found only 24 species in a twenty mile cold tailwater section below Bull Shoals Dam to above the mouth of the Buffalo River. Since 52 of 59 Buffalo River species are known to occur in the region of the confluence, the Buffalo River can be viewed as an important source of species enrichment for the impoverished tailwater fauna of the upper White River.

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