THE FISH POPULATION OF A SPRING-FED STREAM SYSTEM IN SOUTHERN ILLINOIS

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The Big Creek Drainage is located in Hardin County near Elizabethtown. The drainage includes 67 square miles. It lies primarily in limestone formations along the Ohio River and is crossed by several major faults. The drainage is composed of three principal streams: Big Creek, Hog Thief Creek, and Goose Creek. The watershed of the streams is mostly forested. All three streams are spring fed. During the drought period of 1952 and 1953 the streams continued to flow, although the flow of Hog Thief was drastically reduced.

During August and September of 1953 observations on the physical character of streams were made. These observations are the basis for the comments on water depth, etc. given below.

In general the streams have bottoms of gravel, boulders, and slab rock. They are shaded throughout most of their length. Fluctuations in water level amount to several feet in the lower part of the drainage, but the greater portion of the stream system undergoes fluctuations of three or fewer feet.

The habitat afforded by the different streams and, in some instances, by different segments of the same stream varies significantly. Big Creek proper is 15 miles long and along its length changes in the streams are evident. The lower extent of Big Creek has deeply cut banks. Pools 30 to 40 feet wide and up to 500 feet in length are interspersed with relatively short riffles approximately 75 feet in length. This portion of the stream is directly affected by changes of water level in the Ohio River. During the August observation period the rate of flow was 123 cubic feet per minute. Temperature of the water was 74° F. at which time the air temperature during the day reached 90°, and night-time temperatures were 60° F. In July, 1954, during a particularly hot period, at which time the air temperature was 91° F., the water temperature was 80° F. Two miles above the Ohio River the stream width was 20 feet. Pools constituted 75% of the water area and the pool depths averaged 3 feet. In August the average rate of flow was 141 cubic feet per minute. In the headwaters of Big Creek several miles upstream from the Ohio River, stream width was 20 feet and pools were 2 feet deep. At the time air temperature ranged from 60° to 90° F., the water temperature was 65 degrees F. In August, 1956, when the afternoon, day-

time air temperature was 83° F., water temperature was 72° to 78° F.

Hog Thief Creek is five miles long and at normal water stages it affords an excellent series of large pools and riffles. It is the least stable of the three streams. During the drought period of 1953 its above-ground flow was greatly reduced. However, there may have been significant water movement in the gravel of the stream bed. Hog Thief is fairly homogeneous throughout its length. It has a width of 15 to 20 feet and pools 50 to 100 feet in length and 2 feet deep. Pools constitute about 70% of the water area. Despite its limited flow, water in Hog Thief Creek does not get particularly warm. Two miles upstream from Big Creek in August, 1953, the water temperature fluctuated from 69° to 75° F., at which time the air temperature ranged from 65° to 90° F. Decker Spring, the largest spring in the drainage area, empties into Hog Thief Creek. The water of the spring remains at 56° F. throughout the summer.

Goose Creek is only two miles long. It is quite narrow and would be of little interest except that it has an abundant supply of spring water. It also appears to be less affected by drought. In more critical times such a stream might serve as a reservoir for such species as the smallmouth bass and rock bass. The temperature of Goose Creek was 62° F., at which time the air temperature was 73° F. During August, 1956, when the afternoon-daytime temperature was 84° F., the water temperature of Goose Creek varied from 69° F., in the headwaters to 75° F., in the lower waters. Rate of flow in Goose Creek is 26 cubic feet per minute.

Methods of Study

Three sampling stations were established on Big Creek, three on Hog Thief Creek, and one on Goose Creek. The establishment of the stations was based on changes in the physical condition of the stream and accessibility of the areas. A sampling station consisted of one or two prominent pools and riffles.

The study was carried out during August and September, 1953. There had preceded this sampling a two-year period of sub-normal rainfall. Thus we might anticipate that the springs feeding the stream were reduced in flow.

Sampling was with an electrical shocking device supplemented by a minnow seine. Nets were placed above and below the area to be sampled. Then electrodes were run back and forth through both pools and riffles and all fish that were stunned were dipped with a hand net. This process was continued until fish were no longer obtained. The area was then seined with a minnow seine. Due to water depth at the lower station on Big Creek, it was necessary to modify the usual procedure by using a boat with the electrodes mounted on booms on the bow of the boat.

The fishes were placed in formalin and within a period of one month they were weighed and measured. Where practical, ages were determined by the scale method. For a few species it was possible to estimate the ages by length-frequency distributions. Bodyscale relationships were not calculated; the rela-

TABLE 1.—Growth Rate of Golden Redhorse Taken from Big Creek Drainage in Summer and Fall of 1953.

Age group, years	Number fish	Measured average standard length (mm.)	Calculated standard length in mm. at end of year						
			1	2	3	4	5	6	7
0	1	82	.....	.....	.....	.....	.....	.....	.....
1	58	79	39	.....	.....	.....	.....	.....	.....
2	40	125	37	86	.....	.....	.....	.....	.....
3	11	161	37	80	124	.....	.....	.....	.....
4	2	216	32	75	152	188	.....	.....	.....
5	14	232	42	87	136	178	210	.....	.....
6	2	242	45	104	146	188	215	234	.....
7	1	355	56	143	198	252	288	316	338
Weighted mean standard length (mm.)			41	86	135	184	215	261	338
Total length (inches)			2.0	4.1	6.5	8.8	10.0	12.5	16.0
Annual length increment (mm.)			41	48	67	42	31	22	77

Total length (inches) = 0.048 standard length (mm.) (Lewis and Elders, 1953).

TABLE 2.—Growth Rate of Common Shiner Taken from Big Creek Drainage, Summer and Fall, 1953.

Age group, years	Number fish	Measured average standard length (mm.)	Calculated standard length in mm. at end of year				
			1	2	3	4	5
1	3	54	27	.....	.....	.....	.....
2	30	78	29	57	.....	.....	.....
3	7	98	29	62	82	.....	.....
4	1	103	20	52	71	90	.....
5	1	132	24	40	68	104	126
Weighted mean standard length (mm.)			28	58	79	97	126
Total length (inches)			1.4	2.9	4.0	4.8	6.5
Annual length increment (mm.)			28	29	21	27	22

Total length (inches) = 0.050 standard length (mm.) based on 517 specimens in the standard-length range 17 to 132 mm.

TABLE 3.—Growth Rate of Spotted Bass Taken from Big Creek Drainage in Summer and Fall of 1953.

Age group, years	Number fish	Measured average standard length (mm.)	Calculated standard length in mm. at end of year					
			1	2	3	4	5	6
0	2	46	.....	.....	.....	.....	.....	.....
1	8	127	74	.....	.....	.....	.....	.....
2	5	157	68	125	.....	.....	.....	.....
3	5	189	73	131	168	.....	.....	.....
4	3	190	76	125	159	182	.....	.....
5	5	237	72	129	167	198	223	.....
6	3	215	51	97	138	162	180	204
Weighted mean standard length (mm.)			70	123	160	184	207	204
Total length (inches)			3.4	6.0	7.7	8.8	9.9	9.8
Annual length increment (mm.)			70	54	37	27	23	24

Total length (inches) = 0.048 standard length (mm.) (Carlander, 1950).

TABLE 4.—Growth Rate of Green Sunfish Taken from Big Creek Drainage in Summer and Fall of 1953.

Age group, years	Number fish	Measured average standard length (mm.)	Calculated standard length in mm. at end of year				
			1	2	3	4	5
0	3	46	.....	.....	.....	.....	.....
1	5	56	29	.....	.....	.....	.....
2	10	87	29	59	.....	.....	.....
3	25	93	25	52	71	.....	.....
4	1	163	39	91	131	147	.....
Weighted mean standard length (mm.)			27	55	73	147	.....
Total length (inches)			1.3	2.6	3.5	7.2	.....
Annual length increment (mm.)			27	29	19	16	.....

Total length (inches) = 0.047 standard length (mm.) (Lewis and Elder, 1953).

tionships were assumed to be in the order of a straight line.

In the discussion that follows, the status of each species of fish represented in the Big Creek population is compared to the status of the fish in the southern Illinois area. The area status is based on several years of collecting by various personnel of the Department of Zoology and Cooperative Fishery Research Laboratory of Southern Illinois University.

Common white sucker, *Catostomus commersoni.*—One percent of the total fishes collected. There was no indication of year-class dominances.

Hogsucker, *Hypentelium nigricans.*—Although only two specimens of the hogsucker were obtained, it was surprising to find this fish since it so seldom is collected in the southern Illinois area.

Creek chubsucker, *Erimyzon oblongus.*—The creek chubsucker is not found in dense populations in any of the southern Illinois waters and constituted less than one percent of the total collections in this study. Sixteen of the 17 specimens taken were from Hog Thief, the warmest of the headwater streams.

Golden redhorse, *Moxostoma erythrurum.*—Two percent of the total collection. The oldest specimen taken was in its eighth summer. The majority of the population was made up of one- and two-year-olds with an average standard length of 79 and 125 mm., respectively (Table 1.)

Creek chub, *Semotilus atromaculatus.*—Seventeen taken. The calculated total length at each annulus was 78 and 96 mm. for the first and second years of life, respectively.

Redfin shiner, *Notropis umbratilis.*—Fourteen were taken.

Common shiner, *Notropis cornutus.*—Twelve percent of the total catch. Dense populations of it are rare in southern Illinois. It was particularly abundant in the colder water of Goose Creek. The length-frequency distribution reveals a young-of-the-year peak at 27 mm. and a one-year-old peak at 52 mm. of standard length. There is a suggestion of a peak at 67 mm. which would be the two-year-old group (Fig. 1). The common shiner could also be aged by the scale method (Table 2). The ages arrived at independently by the length-frequency method and scale method corrobated each other.

Bluntnose minnow, *Pimephales notatus.*—Sixteen percent of the total fishes taken. This species, in southern Illinois in general, is not as common as the stoneroller.

Length-frequency distribution of 660 specimens of bluntnose minnows from the drainage revealed a young-of-the-year peak at 27 mm. and a one-year-old peak at 52 mm. (Fig. 1). Approximately 60% of the fish were young-of-the-year, and the majority of the remainder were one-year-olds.

Stoneroller, *Campostoma anomalum.*—Thirty-three percent of the fishes in all

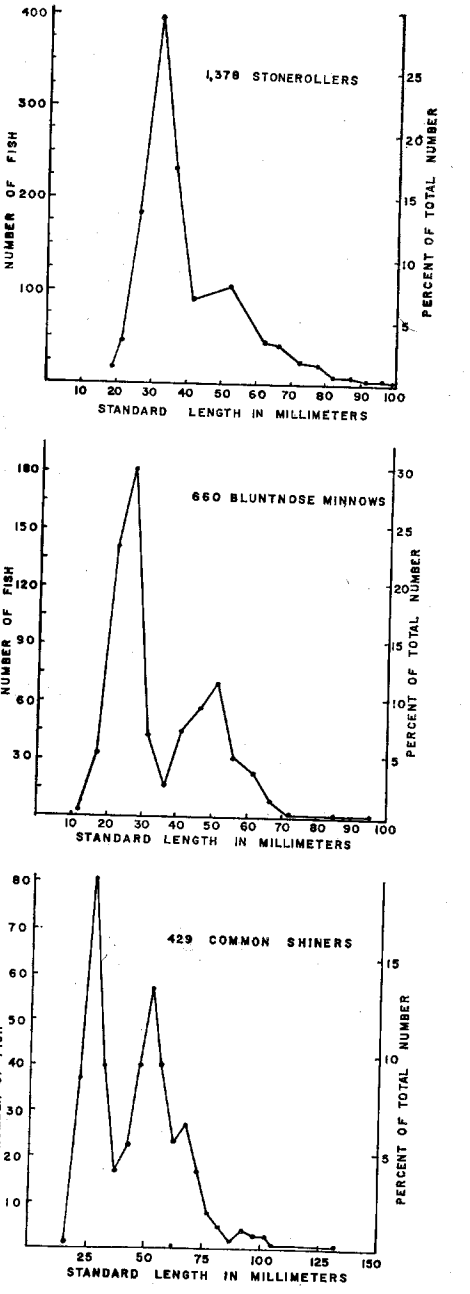

FIG. 1.—Length-frequency distribution of three of the common minnows of the Big Creek Drainage.

TABLE 5.—Growth Rate of Longear Sunfish Taken from Big Creek Drainage in Summer and Fall of 1953.

Age group, years	Number fish	Measured average standard length (mm.	Calculated standard length in mm. at end of year				
			1	2	3	4	5
0	8	38	.....	.....	.....	.....	.....
1	130	46	22	.....	.....	.....	.....
2	100	64	24	47	.....	.....	.....
3	39	82	27	49	68	.....	.....
4	47	87	25	45	62	76	.....
5	17	105	28	50	67	82	95
Weighted mean standard length (mm.)			24	47	65	78	95
Total length (inches)			1.2	2.2	3.1	3.7	4.6
Annual length increment (mm.)			24	27	18	15	13

Total length (inches) = 0.048 standard length (mm.) (Lewis and Elder, 1953).

samples. It is a very prominent fish in the clear-water streams of southern Illinois area (Lewis and Elder, 1953). It was found that the stoneroller was less abundant in Goose Creek, the coolest of the streams, and in the lower part of Big Creek where the water was quite sluggish. It was most abundant in Hog Thief Creek and upper Big Creek where the environment was intermediate between the two extremes. This area of particular abundance is quite similar to the headwaters of Hutchins and Clear creeks of the southern Illinois area, characterized by dense stoneroller populations (Lewis and Elder, 1953).

The length-frequency of 1,378 stonerollers from the Big Creek drainage shows a peak at 32 mm. in standard length and another at 52 mm. (Fig. 1). Since the sample was taken in August, the 32 mm. peak may be considered to represent young-of-the-year and the 52 mm. peak, the one-year-old fishes. Thus young-of-the-year made up about 70% of the stoneroller population. A large part of the balance of the population was composed of one-year-olds.

Channel catfish, *Ictalurus punctatus*, and yellow bullhead, *I. natalis*.—The channel catfish and yellow bullhead were poorly represented. The total collection included 4 of the former and 3 of the latter species.

Madtom, *Schilbeodes miurus*. — The madtom was represented in the collection by two specimens.

Grass pike, *Esox americanus*.— Only two specimens taken.

American eel, *Anquilla rostrata*.—The collections included only one.

Blackstripe topminnow, *Fundulus notatus*.—This species is quite common in southern Illinois. It is to be seen swimming on the surfaces of most streams and lakes. In the present survey, on a numerical basis, it made up 2% of the catch.

Rainbow darter, *Etheostoma caeruleum*, and Johnny darter, *Etheostoma nigrum*.—The rainbow was by far the most abundant darter in the collections, 10% of the total. It was equally abundant in the coldest water and that of average temperature, but was not abundant in the sluggish waters of the lower portion of the drainage.

Stripe-tailed darter, *Etheostoma kennicotti;* spot-tailed darter, *Etheostoma squamiceps;* and log perch, *Percina caprodes*.—Specimens of each were in the collections. The stripe-tailed darter was particularly abundant in the cold water of Goose Creek. It constituted 17% of collections from Goose Creek but only 3 and 4% in the warmer waters and was absent from the lower portions of the drainage.

Smallmouth bass, *Micropterus dolomieu*.—It was something of a surprise to find a well-established population of smallmouth bass in southern Illinois. It was not as abundant, however, as the spotted bass. Its rate of growth was nor-

mal. Fish in their second summer were the most abundant. These second-summer fish had reached a length of 7.2 inches total length.

Spotted bass, *Micropterus punctulatus.*—Of the various game fishes found in the Big Creek Drainage, the spotted bass probably offers the best possibility for management. The greater abundance of the spotted bass in the drainage, as compared with the smallmouth and largemouth, suggests that the habitat is more suited to it. Spotted bass in all of the age groups were fairly equally represented (Table 3).

Largemouth bass, *Micropterus salmoides.*—Only one largemouth was taken. It is interesting that the environment offered by the clear-water streams in the southern Illinois area permits the dominance of spotted over largemouth bass. Further evidence of this is to be found in a study of the Clear Creek Drainage (Lewis and Elders, 1953).

Warmouth, *Chaenobryttus coronarius.*—Two warmouths occurred in the collection.

Green sunfish, *Lepomis cyanellus.*—The green sunfish is to be found in practically all of the waters of southern Illinois. It seems to prosper in clear water streams such as those of the Big Creek Drainage. It is in this type of environment that one often finds an abundance of the larger specimens of this species. The largest green sunfish taken in the present study was 7.7 inches in total length. Fish in their fourth summer were the most abundant; average total length at this age was 4.4 inches (Table 4). This species contributed two percent of the catch on a numerical basis.

Longear sunfish, *Lepomis megalotis.*—On a numerical basis eight percent of the catch was made up of longear sunfishes. It is found in most of the rivers, streams, and larger lakes of southern Illinois, but it is most characteristic of the clear water streams of this area. The population of the Big Creek Drainage is a typical one. The largest specimens taken were 4.6 inches in total length (Table 5).

Rock bass, *Ambloplites rupestris.*—In southern Illinois the occurrence of the rock bass is unusual. In this study, they were found as a well-established population. The largest specimen taken was 6.5 inches in total length and was in its sixth summer.

Northern muddler, *Cottus bairdii.*—The stenothermic nature of sculpins is well known. This characteristic is shown in the present collections. They represented 12% of the collections of Goose Creek and less than 1% of any other collections.

Discussion

The fish populations of the Big Creek Drainage are of particular interest for several reasons. The stream is one of the few spring-fed or partially spring-fed streams in southern Illinois. The fishes include well-established populations of rock bass, smallmouth bass, spot-tailed darter, and striped-tailed darter, all of which are rare in southern Illinois. The variation in temperature between Goose Creek and the other streams made possible observations on habitat preference by different species. The common shiner, northern muddler, and the stripe-tailed darter exhibited particular preference for the colder water, whereas the bluntnose minnow seemed to avoid the cold water.

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