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A POST-IMPOUNDMENT SURVEY OF THE FISHES OF INDIAN CREEK, DEKALB COUNTY, ILLINOIS

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ABSTRACT

A survey of an 18 km segment of the headwaters of Indian Creek was conducted to determine if any changes in fish species composition or distribution had occurred since construction of Lake Shabbona in 1975. Among the species that apparently occurred with some regularity before impoundment, *Carpiodes carpio* may no longer be present. *Etheostoma zonale* and *Percina phoxocephala* were not collected above the lake, and probably were eliminated by the headwater poisoning. *Labidesthes sicculus*, introduced as a forage species in the lake, is now established in Indian Creek above and below the lake. Species diversity index values among the collecting stations show a pattern similar to that obtained in a pre-impoundment survey. The continued presence of several species of fish sensitive to reduced water quality is one of several indicators of overall high water quality of Indian Creek.

INTRODUCTION

Indian Creek, third largest tributary to the Fox River, was dammed in 1975 by the Illinois Department of Conservation (IDOC) to form Lake Shabbona. The impoundment is located south of the Village of Shabbona in DeKalb County, and is managed along with the surrounding land by IDOC as a state recreation area.

In a published pre-impoundment survey of the fish fauna of Indian Creek, Drew and Wildrick (1974) noted that lake construction would include treatment of the headwaters of Indian Creek with rotenone to prevent the introduction of *Cyprinus carpio*. They suggested the stream fish community composition and distribution patterns would undoubtedly be altered by the proposed poisoning and lake construction. Studies elsewhere on the biological effects of impoundments have shown that reservoir construction may result in: 1) the downstream elimination of coldwater fishes (Young and Maughan, 1980) or warmwater fishes (Spence and Hynes, 1971a), depending on the origin of the discharge waters; 2) downstream reduction of benthic invertebrates with temperature-dependent life cycles (Lehmkuhl,

1972; Spence and Hynes, 1971b); 3) invasion of tributary streams by undesirable reservoir fish species (Ruhr, 1957) and; 4) the elimination of highly migratory fish species (Baxter, 1977). The present study was initiated in an attempt to document whether any changes in fish species composition or distribution patterns have occurred since the headwaters of Indian Creek were impounded.

STUDY AREA

Indian Creek originates about 3 km west of the DeKalb County line in Lee County, flowing in a northeasterly direction and paralleling the north slope of the Cropsey Moraine for about 12 km. At this point it turns sharply southward, dissects the moraine, and continues in a generally southerly direction until it enters the Fox River in LaSalle County. Indian Creek has a total length of about 80 km and a total watershed of 743 km^2 (Tichacek and Wight, 1971).

About 12 km from its source, at the point where it cuts through the moraine, the stream enters Lake Shabbona. The lake has a maximum depth of 12.2 m, an average depth of 5.3 m, a surface area of 129 ha, and a watershed totalling 52.2 km^2, 85% of which is row cropland, 10% pasture, and 5% wetland (Ill. EPA, 1980).

Drew and Wildrick (1974) established 5 collecting stations along an 18 km section of the headwaters. These same stations were sampled in this survey, with the exception of station 4, which is located in the present lake bed. Stations 1, 2, and 3 are located 9.2, 5.2, and 1 km, respectively, upstream from the lake, and station 5 is about 8.8 km downstream from the lake. Following the stream classification system of Horton (1945), Indian Creek at stations 1, 2, and 3 is a 3rd order stream and at station 5 is 4th order.

We did not sample the headwater pools upstream from station 1, as was done in the previous study. We did, however, sample on one occasion from another station, designated 3a, situated 1 km downstream from the lake.

The substrate of Indian Creek is primarily gravel and rubble, with lesser amounts of sand and larger rocks. Like most streams in areas of Northern Illinois that are intensively farmed, this original substrate is overlain in pools and slower channels by a layer of silt of variable thickness.

Stations 2, 3, and 5 had both riffles and pools present, with maximum depths ranging from 0.6 m at station 2 to 1.5 m at station 5. Station 1 downstream from the bridge had no distinct riffle or pool areas, but had some channels with moderate current and several shallow, quiet pockets of water created by downed vegetation. Station 1 upstream from the bridge had recently been dredged and was a uniform shallow ditch. Maximum depth at this station was 0.4 m.

In August of 1975 the valve at the dam site was closed and the portion of Indian Creek contained in the lake basin and upstream to about 100 m above station 3 was treated with rotenone (Alec Pulley, IDOC, pers. comm.). The total length of the stream segment poisoned was approximately 3 km and included all of station 3.

MATERIALS AND METHODS

Stations 2 and 5 were each sampled 9 times and stations 1 and 3 were each sampled 8 times between October 1980 and October 1981. All seasons of the year were represented in the collections. The length of stream segment sampled at each

station varied between 100 and 300 m. The variance in length resulted from our attempts to include a similar representation of all available habitat types from each station, although no attempt was made to quantify unit effort for each habitat type. Sampling time was in the range of 45 minutes to 1 hour at each station.

Specimens were preserved and later identified in the laboratory, except for some of the larger suckers, which were identified and counted in the field and released. All collections were made with a 4 m minnow seine having a mesh of 3 mm or a 7.9 m bag seine having a mesh of 7mm.

A diversity index, H′, was calculated for each station using the formula

$$H' = 1/N \ (N \log_{10} N - n_i \log_{10} n_i)$$

as described by Zar (1974) and as used by Drew and Wildrick (1974), where N is the total number of fish and n_i is the number of individuals of each species. Instead of selecting a single month for analysis, as was done in the previous study, we chose to pool all of the data for the entire year for each station, in the belief that this reduces sampling error, eliminates the effects of seasonal distribution patterns, and more accurately reflects the total utilization of each part of the stream.

Additional pre-impoundment collections were made by IDOC personnel at station 3 and in the future lake basin, and post-impoundment collections have been made yearly since 1976 at station 5 by the Northern Illinois University ichthyology class. Data from these collections and from our additional collection at station 3a are not used in the diversity indexes, but are presented only as records of the presence of species not collected by us elsewhere or by Drew and Wildrick (1974).

Names of fish species follow the American Fisheries Society (1980).

RESULTS

A total of 4,955 individuals, distributed among 31 fish species and representing 6 families, was collected at stations 1, 2, 3, and 5 during our surveys (Table 1). The greatest number of species (26) was collected at station 5, the fewest number (17) at both stations 1 and 2. Nineteen species were collected at station 3. In general, we found a greater number of species present with distance from the stream source.

One additional species (Moxostoma erythrurum) was collected at station 3a, and in 6 consecutive years of sampling at station 5 by the NIU ichthyology class, 5 additional species have been recorded: *Noturus exilis*, *Ambloplites rupestris*, *Percina phoxocephala*, *Cyprinus carpio*, and *Esox lucius*.

Five species present in pre-impoundment collections were not captured in our surveys (Table 2), although 3 of these 5 have been recorded on at least 1 occasion by others at station 5 since the creek was impounded. Two species (*Labidesthes sicculus* and *Carpiodes cyprinus*) were collected in the present study but not by Drew and Wildrick (1974).

Diversity index values are presented in Table 3. Although post-impoundment values are consistently higher due to inclusion of an entire year's data, a pattern similar to that obtained by Drew and Wildrick (1974) is evident, with highest values of H′ at stations 2 and 5.

Table 1. Species of fish collected at various sampling stations on Indian Creek, DeKalb County, Illinois, between October 1980 and October 1981, with a record of earlier collections. Data from station 3a represents a single collection made 26 July 1981.

Species	Stations				
	1	2	3	5	3a
Cyprinidae					
Campostoma anomalum	40*	259*	10*	175*	2
Nocomis biguttatus	4	190*	10*	10*	1
Notemigonus crysoleucas	14	10	1*	2	
Notropis cornutus	1*	387*	624*	301*	6
Notropis dorsalis	329*	40*	6*	4*	
Notropis rubellus				108*	
Notropis spilopterus**			1	23	2
Notropis stramineus			3*	15*	
Notropis umbratilus**	14	44	3	115	3
Phenacobius mirabilis**			2		
Phoxinus erythrogaster	98*	258*	5*	3	
Pimephales notatus	17*	88*	97*	132*	1
Pimephales promelas**	11	1			
Rhinichthys atratulus	63*	27*	*	2	
Semotilus atromaculatus	194*	87*	23*	69*	1
Catostomidae					
Carpiodes cyprinus				1	4
Catostomus commersoni	3	27*	7	8*	
Hypentelium nigricans**				3	
Moxostoma erythrurum**					1
Ictaluridae					
Ictalurus melas	9	*	4		1
Ictalurus natalis	1			*	
Notorus flavus				3*	
Atherinidae					
Labidesthes sicculus			2	173	72
Centrarchidae					
Lepomis cyanellus	18	27*		5*	
Lepomis macrochirus		1	166	68*	32
Micropterus dolomieui		*		1*	
Micropterus salmoides**				1	2
Percidae					
Etheostoma flabellare**		214	17	78	3
Etheostoma nigrum	31*	27*	21*	12*	
Etheostoma spectabile	34*	33*	10*	15*	
Etheostoma zonale				15*	1

* Species collected by Drew and Wildrick (1974) in October 1971.

** Species collected by Drew and Wildrick (1974) between October 1971 and October 1972, locality not given.

Table 2. Fish species not collected in the present study which were collected by Drew and Wildrick (1974) from Indian Creek, DeKalb County, Illinois.

Species	*Locality*
*Cyprinus carpio**	station 5
Carpiodes carpio	headwater pools
*Ambloplites rupestris**	station 5
*Percina phoxocephala**	unknown
Percina maculata	unknown

* Species collected since impoundment at station 5 by NIU ichthyology class.

Table 3. Diversity index values for stations 1, 2, 3, and 5, October 1980 to October 1981, Indian Creek, DeKalb County, Illinois. Pre-impoundment data of October 1971 (Drew and Wildrick 1974) in parentheses.

	Stations			
	1	2	3	5
N - total no. of specimens	881	1720	1012	1342
	(847)	(503)	(1583)	(1053)
S - total no. of species	17	17	19	26
	(10)	(14)	(13)	(20)
H' - index of diversity	.8538	.9842	.5981	1.0509
	(.6947)	(.8409)	(.6607)	(.8496)

DISCUSSION

Considering the relatively inefficient collection methods used in both pre- and post-impoundment studies, the potential for considerable sampling error to occur must be large, especially in view of the fact that pre-impoundment distributional data are based on a single collection at each station. Inferences drawn through direct comparison of both sets of data must therefore be made with caution. Despite these problems, the distribution of fishes in Indian Creek is remarkably similar between the two studies.

As indicated previously, 3 of the 5 species collected by Drew and Wildrick (1974) but not in the present survey have been collected by others at station 5 since impoundment. Of these, *Ambloplites rupestris* has been collected recently, but is probably distributed sporadically and in low numbers. *Percina phoxocephala* had not been captured since 1976, at which time the reservoir was being filled. Indian Creek at station 5 was a series of stagnant, isolated pools, and fish were highly concentrated. In view of the relative intolerance of *P. phoxocephala* to degraded stream conditions, we recognized that these adverse conditions may have contributed to the elimination of this darter for some distance downstream from the impoundment. However, during a collecting trip to station 5 at the conclusion of the annual meetings of the American Society of Ichthyologists and Herpetologists in June 1982, 2 individuals of *P. phoxocephala* were captured. If unfavorable environmental conditions at the time of impoundment resulted in the decimation of this darter, its reappearance may indicate stream conditions have improved to pre-impoundment levels and re-colonization by *P. phoxocephala* may be possible.

Cyprinus carpio is present below the impoundment at station 5, but apparently is not abundant. Above Lake Shabbona it seems to be absent, although we did not sample the series of headwater pools upstream from station 1, which was the only locality where *C. carpio* was collected by Drew and Wildrick (1974). These populations would not have been affected by the headwater poisoning, but as of 1981 no specimens of *C. carpio* have been reported from Lake Shabbona (Alec Pulley, IDOC, pers. comm.).

The status of the other 2 species collected before but not after impoundment is uncertain. *Carpiodes carpio* was recorded by Drew and Wildrick (1974) at station 5 and by IDOC personnel in 1974 in the future lake basin, but has not been collected since. Presumably it is no longer present in the creek, although its preference for deeper pools where vegetative cover is present (Smith 1979) would make it a difficult species to collect by our methods.

The collection locality of *Percina maculata* was not identified by Drew and Wildrick (1974), but this species has not been collected since their study, nor was it present in IDOC pre-impoundment surveys. It seems likely the collection record represents a straggler.

Of the species recorded only since impoundment, *Notorus exilis*, represented by a single specimen from station 5, was recorded by Forbes and Richardson (1920) from a locality approximating our station 5, and records exist for other creeks in the Fox River system (Smith 1979), but it is reported as being extremely sporadic throughout its known range. The single specimen from station 5 may represent a migrant from lower stretches of Indian Creek. *Esox lucius*, also represented by one individual from station 5, may also be a migrant from downstream areas.

Carpiodes cyprinus, collected by us at station 5 and station 3a immediately below the lake, was also present in IDOC pre-impoundment surveys in the figure lake basin, and there is no indication its distribution has changed since.

Labidesthes sicculus, recorded from Indian Creek first in 1978 and now present in large numbers below the lake and less common above it, was introduced into Lake Shabbona in 1977 as a forage species (Alec Pulley, IDOC, pers. comm.) and has apparently established itself successfully outside of the lake. It is native to other streams in the Fox River system (Smith 1979), and there is no indication its establishment in Indian Creek has had any impact on the existing fish fauna.

We observed a general increase in diversity with distance from the stream source, with the exception of station 3. Drew and Wildrick (1974) attributed the greater diversity at stations 2 and 5 to greater water depth; however, we noted a progressive increase in water depth from upstream to downstream stations. Station 3 consisted of a disproportionate amount of slow, uniform channel with little structure, and stretches of the stream bottom were littered with trash which made seining difficult. Thus, the representation of species was very inequitable, and our samples may not have reflected the actual species composition as accurately as they did at the other stations. Because of the likelihood of uneven longitudinal distribution of stream fishes and the consequent likelihood of sampling error, species diversity alone may be an inadequate measure of stream fish communities, at least with the sampling methods employed in this study. The greater number of species collected at station 3 over stations 1 and 2 is probably a better indicator of the greater abundance of available resources in the larger stream segment that contains station 3.

The poisoning of the 3 km segment of Indian Creek above the dam could have eliminated species above the impoundment whose upstream distributional limit was contained in that segment. IDOC pre-impoundment surveys indicated the presence of *Etheostoma zonale* and *Percina phoxocephala* at stations in the future lake basin and as far upstream as station 3, all of which were affected by the poisoning. Although suitable habitat still exists at station 3, neither of these species was captured there during our surveys, even though *E. zonale* was collected at station 3a a short distance downstream from the dam. It is possible both of these species may be permanently eliminated upstream from the lake.

Despite the initial impact of headwater poisoning and downstream reduction of water flow associated with reservoir construction, at this point it does not appear there has been any serious alteration of the composition and distribution of stream fishes in Indian Creek. Indian Creek still harbors a high quality, diverse fish fauna, indicative of overall high water quality. This assessment is based on an evaluation of the fish communities present in Indian Creek with regard to fish community parameters proposed by Karr (1981). The specific characteristics of the fish communities of Indian Creek that are indicative of high environmental quality and stability include the presence of a large number of species (30-35) considering the size and geographic location of the stream, the presence of intolerant species (*Etheostoma zonale, Hypentelium nigricans, Phoxinus erythrogaster, Ambloplites rupestris*), a low proportion of tolerant species (*Pimephales promelas, Cyprinus carpio, Lepomis cyanellus, Notemigonus crysoleucas*), and a well-balance representation of all trophic levels. In view of the deterioration in many areas of Illinois of high-quality streams that may have unique fish faunas, we believe a high priority should be

placed on recognizing and preserving these unique stream elements when considering stream projects such as reservoirs, and suggest that continued monitoring of the fish fauna of Indian Creek is advisable to detect environmental changes that might be associated with reservoir aging, and as a sensitive indicator of overall watershed quality.

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