
Preliminary Observations on the presence of Stream-Inhabiting Fishes in Tenkiller Reservoir, a New Oklahoma Impoundment¹

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A post-impoundment investigation of the fisheries resources of Tenkiller Reservoir, Oklahoma, was conducted by the Oklahoma Fisheries Research Laboratory in the summer and fall of 1953, one year after inundation was begun. A comparison of these data with preimpoundment fish collections in the Illinois River (7, 11, 14) showed, as expected, that some faunal changes had occurred during the first year of impoundment. Of particular interest was the unexpected presence in the lake of numerous fishes which are usually found in fast-flowing water and riffle habitats in Oklahoma. A search of the literature to determine to what extent various stream species are known to remain in, or disappear from, lake habitats following impoundment of their native stream revealed very little information. Correspondence with numerous ichthyologists and fishery biologists throughout the United States substantiated this finding, but also

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revealed the fact that several workers have made unpublished observations on such events.

In Oklahoma, post-impoundment fishery investigations have largely been limited to growth-rate and population studies of sport and commercial fishes. The few studies concerned with the fish fauna of older Oklahoma lakes (5, 6) revealed the absence of many cyprinids and percids that commonly inhabit state streams (3, 7, 14). Hall and Latta (9) compared pre- and post-impoundment fish samples in the stilling basin below Wister Dam, Oklahoma, and concluded that the population was progressing from that endemic to the Poteau River to one more commonly associated with Oklahoma reservoirs.

Information from other states concerning the fate of stream fishes in impoundments is likewise scanty or irrelevant. Wickliff (16) gave evidence which indicated that within 8½ months following the impoundment of one Ohio stream the characteristic stream species tended to disappear and the lake species began to appear. The extensive post-impoundment investigations above and below Lake Keokuk, Iowa (1, 2) were primarily concerned with the effects of the dam upon the commercial fishery of the upper Mississippi River. The few comparative pre- and post-impoundment studies of fish populations in waters of other states were based either on creel census records (4, 12), or on hoop-net samples (15), and were therefore selective largely for the sport and commercial species.

The purposes of this paper are: (A) to call attention to the dearth of published information on stream-fish succession in impounded waters, (B) to present the data available from Tenkiller Reservoir after one year of impoundment, and (C) to summarize the personal (but unpublished) observations of other fishery workers on this subject.

DESCRIPTION OF SAMPLING AREAS AND METHODS

Tenkiller Dam is located on the Illinois River about 13 miles upstream from its confluence with the Arkansas River, Sequoyah County, Oklahoma. At power-pool level (elevation 630 feet above sea level), the reservoir is 34 miles long, with a shore-line of about 100 miles and a surface area of 12,500 acres (11). Impoundment began on July 1, 1952.

During the main period of this investigation, (June 15 to August 1, 1953), the water level rose from elevation 627 to 628, two feet below power-pool level, and remained at the latter level through October 4, 1953. The depth varied from 130 feet at the dam to 33 feet in the old river channel at a point about 25 miles upstream, adjacent to where the majority of samples were taken. The lake, with predominantly gravel shorelines, receives many clear spring-fed streams. Water in all portions of the reservoir was clear (visibility about 3 feet). Willows, and the tops of oaks, hickories, and sycamores, projected above the water in depths as great as 30 feet. Floating mats of duckweed and filamentous algae partially covered a few small coves. Because the rainfall during early July was above average, surface temperatures remained below 85° F. through the third week of July, but following this period rose to above 90°.

Fish were collected in all portions of the reservoir by use of gill nets, seines, and rotenone. The data obtained from rotenone, successfully used only in creek areas, and gill-net samples, together with seine collections from inflowing creeks and their mouths, were employed only where they contributed to the overall picture of post-impoundment faunal changes. Determination of the presence of stream inhabitants in the lake was based on seine collections from the main shoreline or around islands 20 to 25 miles upstream from the dam. Three types of seines were used during the collecting period, including short, fine-mesh nylon seines (6 to 10 feet long), a 20-foot, ¼-inch-mesh minnow seine, and a 50-foot, ¾-inch-mesh bag seine. The same areas were seined two to four days each week of the six-week survey

period and again on October 4, for a total of 19 seine collections. Scientific and common names used throughout this paper follow Moore (13).

INITIAL POST-IMPONDMENT FAUNAL AND POPULATION CHANGES

Up to the present time 96 species of fishes have been recorded from the Illinois River System (7, 14). Sixty-eight forms were collected in the Tenkiller Reservoir area above the dam in 1953, none of which were new to the drainage. Several of the species not collected in the 1953 sample (*Hyp. psis storeriana* and *H. aestivalis*: *notropis percobromus*, *N. duchanani*, and *N. biennatus*; and *Hybognathus placita*, among others) had previously been taken only near the mouth of the river. These possible wanderers from the silty Arkansas River (14) would not likely be found in other portions of the clear Illinois River at any time. The restricted habitats of other species in the Illinois River system (*Chrosomus erythrogaster*, *Notropis cornutus*, and *Schilbeodes miurus*), remain outside the limits of the reservoir area, and they likewise cannot be considered casualties of impoundment. On the other hand, the upstream movement of certain migratory fishes (e.g., *Hiodon*, *Alosa*, *Anguilla*, and *Stizostedion*) which have been collected only in small numbers, will be prevented by the dam. Fishes previously abundant in Illinois River collections, which were not taken in the Tenkiller Reservoir in 1953, and the absence of which may be partly accountable by the changed environment, include *Noturus flavus*, *Schilbeodes nocturnus*, and *Hadropterus phoxacephalus*. Two other species, *Etheostoma punctulatum* and *Cottus caroliniae*, were absent from lake samples but were still abundant in tributaries flowing into the reservoir.

Small fishes such as *Fundulus*, *Gambusia*, and *Labidesthes*, usually associated with overflow pools, oxbows, and vegetated backwaters in and along streams, were already established over the lake, as expected. Several minnows, including *Notemigonus crysoleucas*, *Notropis iutrensis*, *Pimephales notatus*, and *Campostoma anomalum*, and the logperch, *Percina caprodes*, all of which are known to inhabit some Oklahoma lakes (5, 6), were present in Tenkiller Reservoir in 1953, the first three in greater numbers than in the 1952 collections. More chestnut lampreys, *Ichthyomyzon castaneus*, were collected in the initial post-impoundment study than during any previous survey of the Illinois River.

As was expected, early post-impoundment population changes occurred among many of the game, pan, and coarse fishes. Detailed comparisons of the 1952 and 1953 populations of these fishes in Tenkiller Reservoir as determined from all sampling methods are presented elsewhere (8). The following general statements regarding their relative status after impoundment and changes in abundance from pre-impoundment samples concern only the "typical" stream-inhabiting forms.

Yellow bullhead and rock bass declined in numbers from pre- to post-impoundment samples and were scarce in 1953 collections, but the abundance of several other species showed relatively little alteration after impoundment. Smallmouth and spotted basses, hogsucker, and golden redborse were still taken in large numbers; river and black redborses remained relatively scarce in collections. The future status of most of these species in Tenkiller Reservoir is questionable. Spotted bass are known from several eastern Oklahoma lakes, but, of the others, there are only scattered records of yellow bullhead and golden and black redborses from state impoundments (6, 7). Very few adult smallmouth bass were collected during this survey, and whether the large number of young hatched in 1953 will remain in the lake is doubtful.

Few accurate predictions concerning the future fish populations of a reservoir can be made on the basis of an initial post-impoundment sample. With reference to Keokuk Dam, Coker (1) stated "It is evident that the dam could not have exerted its full effect upon the fish life of the upper river within a year and that whatever effect may have followed a year after

the obstruction was completed should have been more conspicuous in subsequent years." Whether the impoundment of Tenkiller Reservoir will have a temporary or permanent effect upon any of the game, pan, and coarse fishes will be determined only from future investigations.

"TYPICAL" STREAM SPECIES PRESENT AFTER IMPOUNDMENT

Weekly seine totals of some of the fishes usually associated with Oklahoma streams and collected from Tenkiller Lake shore areas are presented in Table I. The game, pan, and coarse species previously discussed were not included, since data from the seine collections, along with gill-net and rotenone samples, were employed in consideration of their relative abundance in the lake. Likewise, the forage species common to both stream and lake habitats in Oklahoma were excluded.

The remaining group consists of 1 catostomid, 1 ameiruid, 14 cyprinids, and 6 percids. With the exception of *Notropis umbratilis*, a species most abundant in plains streams of sluggish character, these fishes are found in Oklahoma in the clear eastern streams, and a few of the clear southern streams. The majority are confined to the Ozark Region in northeastern Oklahoma. In spite of their distribution, it is impossible to place strict limits upon the type of habitat to be occupied by these fishes. A few specimens of *Notropis umbratilis*, *N. zonatus*, *N. camurus*, and *N. boops*, *Dionda nubila*, *Schilbeodes exilis*, *Etheostoma spectabile*, and *E. whipplei* have been collected in or near the mouths of creeks in other lakes (5, 6). Most of the Ozarkian stream minnows and darters present in the confines of Tenkiller Lake were found in much greater numbers in their more natural habitat just beyond the influence of the lake environment. The species composition of lake areas near stream mouths is undoubtedly influenced by the proximity of different habitats, and for this reason the samples of fishes collected near the mouths of creeks emptying into Tenkiller Reservoir were not considered as evidence for the existence of stream fishes in the lake.

TABLE I

Weekly Collection Totals of Some of the Stream-Inhabiting Fishes Seined From Lake Habitats of Tenkiller Reservoir, 1953
(Number of collection days per week in parentheses)

SPECIES	JUNE	JUNE	JUNE 28	JULY	JULY	JULY	OCT.	TOTALS
	15-20 (4)	21-27 (3)	JULY 4 (4)	5-11 (2)	12-18 (3)	19-25 (2)	4 (1)	
<i>Catostomus commersonni</i>	1	—	—	—	—	—	—	1
<i>Semotilus atromaculatus</i>	20	—	4	—	—	—	—	24
<i>Hybopsis biguttata</i>	17	20	19	1	9	2	4	72
<i>Hybopsis amblops</i>	30	2	10	—	—	—	2	44
<i>Hybopsis dissimilis</i>	6	3	9	—	5	—	—	23
<i>Notropis rubellus</i>	3	5	30	—	—	—	5	43
<i>Notropis umbratilis</i>	—	—	1	—	1	—	—	2
<i>Notropis zonatus</i>	115	69	67	5	20	2	22	300
<i>Notropis greenei</i>	4	2	44	15	65	—	7	137
<i>Notropis spilopterus</i>	—	—	12	2	8	1	7	30
<i>Notropis camurus</i>	—	—	28	13	24	6	34	105
<i>Notropis boops</i>	3	12	128	19	33	6	67	268
<i>Notropis volucellus</i>	—	25	15	—	—	—	—	40
<i>Dionda nubila</i>	52	39	60	1	23	—	6	181
<i>Pimephales tenellus</i>	1	—	5	—	—	—	—	6
<i>Schilbeodes exilis</i>	1	2	—	—	—	—	—	3
<i>Etheostoma saxatile</i>	2	2	4	—	—	—	—	8
<i>Etheostoma zonale</i>	37	83	61	—	—	—	1	182
<i>Etheostoma spectabile</i>	18	28	1	—	—	—	—	47
<i>Etheostoma whipplei</i>	1	2	2	—	—	—	—	5
<i>Etheostoma flabellare</i>	1	—	—	—	—	—	—	1
<i>Etheostoma biennioides</i>	3	36	26	—	—	—	—	65

The total number of individuals of each stream species taken in 19 seine collections in Tenkiller Reservoir (Table I) indicated that at least four species, *Pimephales tenellus*, *Schilbeodes exilis*, *Etheostoma whipplei*, and *E. flabellare*, have almost disappeared from the impounded water areas, since these fishes were still abundant in the main stream and/or tributaries. *Catostomus commersonni* and *Notropis umbratilis* are rare in the entire Illinois River System (14). With regard to certain species, however, the total number seined in the lake might be misleading if consideration were not given to the time when they were collected.

Semotilus atromaculatus, *Notropis volucellus*, and, with the exception of a single specimen in October, all species of *Etheostoma* were taken only during the early weeks of the survey. Thus, their appearance in the lake may have been an initial, temporary condition. Conversely, specimens of *Notropis spilopterus* and *N. camurus* were absent from the first two weekly samples but were represented in all succeeding weekly collections. The latter condition also applied to *Notemigonus crysoleucus* and *Pimephales notatus*, two of the minnows often found in Oklahoma lakes.

Stream fishes seined from the lake shores during every week of the investigation included *Hybopsis biguttata*, *Notropis zonatus*, and *Notropis doops*. Two other species, *Notropis greeni* and *Dionda nubila*, were collected in every week except the final one of the summer period. Seine collections made during the last week were not considered to be representative of species present in the lake. With increased daily water temperatures after the third week in July, most species apparently moved into deeper and cooler waters, and shoreline seining was thereafter relatively unsuccessful.

The lack of personal experience with post-impoundment stream fish succession and of published information with which to compare the above data made it difficult to account for the prolonged presence in the lake of some of these species, especially the riffle darters and minnows. Without documentary evidence, speculation as to how long these species might remain in such an environment is scarcely feasible. However, the accumulated experiences of several ichthyologists and fishery biologists from various parts of the United States provide a few accounts of the occurrences of stream fishes in lake habitats and some information on the length of their retention in impounded waters.

DISCUSSION

The author corresponded or personally communicated with Drs. Reeve Bailey (Michigan), Jack S. Dendy (Alabama), Carl Hubbs (California), Daniel Manges (TVA), George A. Moore (Oklahoma), Edward C. Raney (New York), and Milton Trautman (Ohio), and Mr. Robert G. Martin (Virginia) regarding stream fishes in impounded waters. Details of their contributions are not included in this paper but will be employed later in a different report.

A summary of their experiences and observations on this subject indicates that (A) the species which inhabit quiet-water areas of streams are usually present in the impoundments; (B) species which live in fast-water habitats of streams usually disappear from the impoundments on those streams, some more rapidly than others; (c) stream species are often found in lakes around the mouths of tributaries, but this may be attributed to wandering from the typical habitat; (D) during winter and early spring some "typical stream" species may be present in reservoirs for several years following impoundment; and (E) under certain environmental conditions, such as lakes with clear water, little or no siltation of bottoms, and gravel and rock shorelines, some "typical stream" species may be retained indefinitely.

Tenkiller Reservoir has all of the physical conditions just described, but a few riffle species appear to have disappeared from the impounded water area during the first year of impoundment. On the basis of seine samples, the populations of several other species which are still high in tributary waters, are low in the lake. Nevertheless, at least 30 species usually associated with clear Oklahoma streams, including a few centrarchids and catostomids, but mostly minnows and darters, were seined from lake shores of this year-old reservoir. Several of these species, *Catostomus commersonni*, *Notropis rubellus*, *N. spilopterus*, *N. volucellus*, *Micropterus dolomieu*, and *Ambloplites rupestris*, are common in northern lakes (10), but this report is one of the few to record their presence and that of the other stream fishes in an Oklahoma impoundment.

In spite of their early existence in Tenkiller Reservoir, or records of their presence in northern lakes under certain environmental conditions, continued collections in this impoundment are necessary to determine whether any of the "typical" Oklahoma stream species survive beyond the initial period of inundation and to furnish more general information on ecological succession in impounded waters. The present material from this new Oklahoma impoundment and brief summary of available information on the subject are presented as a preliminary report to a more detailed analysis when additional data have been secured. Meanwhile, it is hoped that other workers will publish similar information.

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