

An Ecological Study of the Fishes of the Fall and Verdigris Rivers in Wilson and Montgomery Counties, Kansas, March 1954 to February 1955.

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INTRODUCTION

Few, if any, year-round studies have been made on the fishes in Kansas streams. This is due, in part, to the time, energy, and money needed to conduct a year-round study. In March of 1954 (see p. 5 of Prophet's study), the Department of Biology began a survey of the physical, chemical, and biological characteristics of the Fall and Verdigris rivers in Wilson and Montgomery counties of south-central Kansas. A part of the survey was concerned with the fishes in the two rivers; the present study utilizes only a small part of these data that were accumulated during the survey.

The objectives of the present study were to determine the number of species of fishes present and to see to what extent seasonal variation of fishes in collections was evident in each river.

The study would not have been possible without the financial assistance of the Standard Oil Company (Indiana), and the technical and professional assistance of Dr. Frank Cross and Dr. John Breukelman who verified the identification of the fishes collected.

REVIEW OF LITERATURE

Studies in Kansas

Impetus was first given to ichthyology in Kansas in the latter part of the 19th century by several workers. Gilbert (1884, 1885, 1886, and 1889) published notes on the fishes of Kansas. Two preliminary lists of Kansas fishes were prepared by Cragin (1885) and Graham (1885), and Hay (1887) added to the beginning study of fishes in Kansas.

After this inception, few ichthyological investigations were undertaken until the work of Breukelman and Cross in the last decade. Breukelman (1940b) catalogued the fishes in Dyche Museum, University of Kansas. Fifty-six species and subspecies of 10 families made up this collection, which included 26 species from the Verdigris River. Breukelman (1940a) reported 38 species of fishes which were collected in northwestern Kansas rivers, and (1946) reviewed Kansas ichthyology. In a booklet, "What Have I Caught?" (1947), he provided a non-technical reference for the

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identification of larger fishes and a few of the minnows commonly used for bait. He listed 53 species of 15 families. Minckley (1956) in a survey of the fishes of Deep Creek in north-central Kansas collected 13 species. He found the red shiner (*Notropis lutrensis*) comprised 27 per cent of the total number of individuals collected. Cross (1945a) studied the fishes of Cedar Creek and the South Fork of the Cottonwood River in Chase County, Kansas. Forty species of 6 families were included. Ten little known fishes from Kansas were reported by Cross (1945b). Three of these, *Notropis buchanani*, *Schilbeodes nocturnus*, and *Gambusia affinis affinis*, were present in collections of Fall and Verdigris river fishes studied by the author.

Three studies (which included work on the Fall and Verdigris rivers) were reviewed. In a compilation of Kansas fishes in the Kansas State College Museum, Manhattan, Jennings (1942) listed 41 genera, 58 species or subspecies of 13 families. Of these, 6 species were collected in the Fall and Verdigris rivers by I. D. Graham in 1884 and 1885, all of which were in the collections in the present study. Breukelman (1940a) listed 26 species from the Verdigris River. Of these 26 species, 21 were collected by the author. The other study was a post-impoundment survey of the fisheries of the Fall River Reservoir by Schoonover and Thompson (1954). Age and growth rates were studied for 16 species of the larger fishes. Scientific names of these fishes were not given. However, it is likely that only 3 of the 16 were not collected in the present study.

In a preliminary key to the fishes of Kansas, Bishop (1935) listed 99 species of fishes of 21 families in which 3 species of lampreys were not included. Swaim (1948) studied the fishes and history of commercial fishing in the lower Kansas River from Lawrence to Kansas City. He collected 31 species of fishes and listed 11 more species which had been previously collected. Spencer (1955) surveyed the plants and animals of Lake Wooster, campus experimental pond, and reported the conditions of fishes in the lake. Fishes were collected primarily by poisoning with rotenone.

Moore and Buck (1953) listed 42 species of 12 families which were collected from 15 stations on the Chikaskia River in Oklahoma and Kansas.

Studies Outside of Kansas

Trautman (1942) studied fish distribution and abundance as a consideration in stocking programs. He found that stream gradient was the chief limiting factor of the distribution of the smallmouth bass (*Micropterus dolomieu*) in Ohio. This species was most abundant in streams with gradients from 5.0 to 19.9 feet per mile. Spotted bass (*Micropterus punctulatus*) were most abundant in streams with lower gradients, such as the Scioto River having a gradient of 1.5 feet per mile.

Larimore, *et al.* (1952) studied a 4-mile section of Jordan Creek, an 11-mile long stream in Vermillion County, Illinois. Eight sections of approximately equal length were studied quantitatively as to number and weights of each species and family collected. Minnows comprised 75 per cent of the total number and 38 per cent (largest percentage) of the total weight of fishes. Distribution of species was affected by stream gradient, shading of water surface, dominant bottom materials, and use of the surrounding land.

Studies were reviewed which investigated longitudinal succession in streams. "Longitudinal succession should not be thought of in terms of a uniform continuous change; specific conditions and resulting communities may appear at intervals," Odum (1953). In 5 high gradient mountain streams, Burton and Odum (1945) found that temperature, stream size, and gradient of flow were the most important factors in longitudinal distribution. Headwater species ranged the length of streams, and the number of species tended to increase downstream. Shelford (1911) and Thompson and Hunt (1930) studied longitudinal distribution in Illinois streams where the gradient of flow was not greatly different from the source to the mouth. Headwater species exhibited wide tolerances and were found the length of the stream. Other species occupied successive sections of the stream. In Boone County, Iowa, Starrett (1950) found the number of species increased with stream size and area of watershed in the Des Moines River which had a gradient of 1.5 feet per mile.

Lewis and Elder (1953) found the stoneroller to be the most abundant fish in the headwaters of a spotted bass stream in southern Illinois. Spotted bass were not abundant since it was believed this species moved downstream into larger pools during the summer months when the survey was conducted. Belief was based on spring sampling and observations.

An abundance of fishes was studied in the Black River, Missouri. Martin and Campbell (1953) studied the changes which occurred in the populations of small fishes following the construction of a major impoundment. Sixty-eight species were collected, 20 of which were minnows. Funk and Campbell (1953) investigated 34 species of larger fishes as to methods by which they were collected and section of the river in which they were collected. In the headwater portions of the river, red horse, hog sucker, longear sunfish, rock bass, and smallmouth bass were the predominant species. Gizzard shad, flathead catfish, carp, other rough fishes, largemouth bass, bluegill, and crappie became progressively more abundant toward the lowland waters.

Starrett (1951) studied the abundance of minnows in the Des Moines River, Iowa. Abundance depended on fluctuations in water levels which determined spawning success. Channel catfish abundance depended on silt load and water level in June when the species spawned. Starrett re-

ported both he and Johnson (1949) found smallmouth bass spawning success to be correlated with water levels. Johnson, in studying streams near Mankato and New Ulm, Minnesota, noted that bass spawned only once in a period of 10 years. No spawning had occurred because of spring floods and turbid waters. After one successful spawning year, young bass were abundant.

Large number of species from short sections of streams in Indiana were reported by two investigators. In a survey of a 0.5 mile section of Sugar Creek, Boone County, Indiana, Shockley (1949) found 47 species which were collected by seining and trapping, plus 4 more species reported by observers, which he believed to be the largest number of species reported from a single section of a stream in Indiana. The large number of species was attributed to a wide variety of ecological habitats and intensive collecting during two summers. However, Scott (1949) reported 57 species of fishes from a 3-year study of a 0.75 mile section of the Tippecanoe River, northwestern Indiana. Four of these were not collected in the river, but were either reported from the river or collected in cutoff oxbows and back waters of the river.

Since the minnow family was dominant, Gerking (1949) termed three streams "minnow streams" from a study of their populations. He found that more fish by weight live in deep streams than in shallow ones, which would provide a means of predicting stream productivity.

Gerking (1953) stated that, in streams with riffle-pool development, each pool can be more or less considered an isolated population containing a natural population of its own. In experiments with longear sunfish, green sunfish, and rock bass, he estimated the home range to be 100 to 200 feet. Smallmouth and spotted bass, golden redhorse, and hog suckers had home ranges of 200 to 400 feet. Other experiments with longear sunfish and rock bass suggested the hypothesis of territoriality. Shelford and Eddy (1929) stated that permanent stream communities probably exist.

In a summer survey of the stability of a stream fish population, Gerking (1950) studied 9 species of fishes in Richland Creek, Greene County, Indiana. After a flood, 75 per cent of the fishes which had been marked previously were in their original location. Small fishes were affected no more than large fishes. A tendency for fishes to move upstream was noted during periods of high water.

COLLECTION METHODS

Fishes were collected with two types of small drag seines in both pools and riffles at the 4 stations. One type was a knotted twine seine of 0.25 inch mesh 4x20 feet. Seines ranging in size from 8 to 12 feet were constructed from one-sixteenth inch mesh plastic screening material 35 inches in width.



Fig. 1. Pool seining technique.



Fig. 2. Riffle seining technique.

Pool seining (Fig. 1) seemed most effective when the seine was dragged at approximately a 70° angle with the bank to form a V-shaped wedge. Wherever available, the operators dragged the seine toward a natural obstruction in the stream. When an obstruction was not conveniently located, men waded in the water ahead of the seine and attempted to drive the fishes into the seine. In either case, at the end of the haul, the inside operator stopped and the outside operator pivoted and pulled his end of the seine to shore. The seine was hauled onto the bank where the fishes were preserved.

The operators and the rocks, which anchored the lead line on the bottom, held the seine in a stationary position for riffle seining (Fig. 2). With the seine in position, one or more men upstream from the seine turned over large rocks and agitated the stream bottom with their hands and feet. The operation continued downstream from 15 to 30 feet above the seine until the lead line was reached. The seine was pulled from the water and carried to the shore where the fishes were preserved.

AREA OF THE STUDY

The area of this study was in Wilson and Montgomery counties in southeastern Kansas and included both the Fall and Verdigris rivers. In Wilson County, as mentioned previously, the Fall River joined the Verdigris River.

The study area was in the ecotone of the grassland and forest biomes in which deciduous forests occurred in combination with grasslands and cultivated lands. Principal cultivated crops were corn, wheat, oats, soybeans, and alfalfa.

Channels of the two rivers were from 40 to 140 feet in width with sloping banks from 10 to 40 feet in height. Stream gradients were approximately 2.0 feet per mile. Most of the trees along the river were *Populus deltoides* Marsh. (cottonwood); *Plantanus occidentalis* L. (sycamore); *Celtis occidentalis* L. (hackberry); *Ulmus* sp. (elm); *Fraxinus* sp. (ash); *Salix nigra* Marsh. (black willow); *Morus alba* L. (white mulberry); *Morus rubra* L. (red mulberry); *Quercus* sp. (oak); *Acer* sp. (silver maple); *Maclura pomifera* (Raf.) Schneid. (osage orange); *Gleditsia triacanthos* L. (honey locust); *Juglans nigra* L. (black walnut); and *Acer negundo* L. (box elder) (Fernald 1950).

Of the dominant aquatic plants, 3 flowering plants were noted *Jussiaea repens* L. var. *glabrescens* Ktze. (water-primrose); *Sagittaria* sp. (arrowhead); and *Spirodelia* sp. and *Lemna* sp. (duckweed). *Cladophora* sp. was abundant in riffles and *Spirogyra* sp. was also a common alga.

Among the common invertebrate benthos were clams, hellgrammites, crayfishes, leeches, bryozoans, planarians, and mayfly, stonefly, dragonfly, damsel fly, and caddis fly nymphs.



Fig. 3. Typical view of Verdigris River.



Fig. 4. Typical view of Fall River.

Data were collected at 4 stations for this study. One station was located on each of the 2 rivers above their confluence. The remaining 2 stations were on the Verdigris River below the point of their confluence.

A map of the area of study is given in Prophet's study (p. 7). He gives detailed descriptions, also, of Stations I, II, VIII, and IX. Figs. 3 and 4 show the general characteristics of the Verdigris and Fall rivers.

SEASONAL VARIATION IN OCCURENCE OF FISHES IN COLLECTIONS

Forty-two species of fishes in 10 families were collected at Stations I, II, VIII, and IX during this study. Ten species, in addition to these 42, are known to have occurred in the Fall and Verdigris rivers. Breukelman (1940b) listed 5 of these from the Verdigris River, which were *Carpiodes velifer* (Rafinesque) bluntnose river carp; *Minytrema melanops* (Rafinesque) spotted sucker; *Notropis cornuta frontalis* (Agassiz) northern common shiner; *Ameiurus natalis natalis* (LeSueur) northern yellow bullhead; and *Aplodinotus grunniens* (Rafinesque) freshwater drum.

Schoonover and Thompson (1954) also reported the drum in the Fall River Reservoir. They listed three other fishes: *Pomoxis nigromaculatus* (LeSueur) black crappie; *Morone chrysops* (Rafinesque) white bass; and *Stizostedion vitreum vitreum* (Mitchell) wall eye. They also reported that the "walleye" was collected from the stilling basin below the Fall River dam in February, 1953. Fishermen stated that "walleye" had been caught in the vicinity of Station II.

Two species were collected by the author. One specimen of *Schilbeodes isignis* (Richardson) was taken at Station I on July 30, 1955. The other was *Etheostoma whipplei* (Girard) redbfin darter, which was collected in the Verdigris River three miles southeast of Benedict (S. 23, T. 2 8S., R. 15E.) on November 5, 1954. The species was common in the collection.

The following discussion of seasonal variation is arranged in check-list order for the 42 species of 10 families which occurred in collections at Stations I, II, VIII, and IX. In Table I, the months are given in which each of the species occurred in collections. The dates of occurrence of species in collections at Stations I, II, VIII, and IX are tabulated in Tables II-V, respectively.

Family Lepisosteidae, gars

Lepisosteus osseus (Linnaeus)—longnose gar

The longnose gar, the only lepisosteid which was collected, only appeared in May, June, and July collections. (Table I). It appeared in collections on June 19 at Station I (Table II), on May 23 and on July 2 at

Station II (Table III), on June 6 and on July 2 and 31 at Station VIII (Table IV), and on July 2 at Station IX (Table V).

Family Clupeidae, herrings

Dorosoma cepedianum (LeSueur)—gizzard shad

The only clupeid which was present in collections was the gizzard shad. It occurred in 8 months of collection—from April to October and in December. Seasonal occurrence in collections varied for each station. Shad were present in July and September collections at Station I; May, June, and July collections at Station II; June, October, and December collections at Station VIII; and from April to August and in October collections at Station IX.

Family Catostomidae, suckers

Catostomids were represented by 6 species which occurred in 7 months of collection, excluding March, August, December, January, and February. No suckers were present in collections at Station II.

Ictiobus cyprinellus (Valenciennes)—bigmouth buffalo

The bigmouth buffalo occurred in the June 19 collection only at Station VIII.

Ictiobus bubalus (Rafinesque)—smallmouth buffalo

This species was present in collections at Station VIII on March 13 and on July 2, 10, and 23; and at Station IX on May 8 and on June 6.

Carpionodes carpio carpio (Rafinesque)—northern river carpsucker

River carpsuckers appeared in collections at Station VIII only on May 29 and on July 17.

Moxostoma erythrurum (Rafinesque)—golden redhorse

The golden redhorse appeared in collections at Station I on April 16 and on October 23; and at Station VIII on November 13.

Moxostoma aureolum pisolabrum Trautman—pealip shorthead redhorse

Pealip shorthead redhorses were present in collections at Station I, only, on July 10 and on September 25.

Moxostoma carinatum (Cope)—river redhorse

At Station IX, the only river redhorse was taken in the April 16 collection.

Family Cyprinidae, minnows

Cyprinids, represented by 13 species, showed no seasonal variation in months of collection. Nine of the 13 species were present in at least 10 of the 12 months of collection; one species occurred in 9 monthly collections, and 3 species were taken in no more than 2 months.

Cyprinus carpio Linnaeus—German carp

The only German carp was taken in the September 18 collection at Station II.

Notemigonus crysoleucas (Mitchell)—golden shiner

TABLE I. Months of occurrence of 42 species of fishes in collections at Stations I, II, VIII, and IX.

Common Family	Common Name	Months Collected	Total Months
Gar	Longnose gar	M J J	3
Herring	Gizzard shad	A M J J A S O D	8
Sucker	River carpsucker	M J	2
	Smallmouth buffalo	M J J	3
	Largemouth buffalo	J	1
	Shorthead redhorse	J S	2
	River redhorse	A	1
	Golden redhorse	A O N	3
Minnow	German carp	S	1
	Stoneroller	M A J J A S O N D	9
	Golden shiner	M	1
	Ghost shiner	M A M J J O N D J F	10
	Mimic shiner	M A M J J A S O N D	10
	Bluntnose minnow	M A M J J A S O N D	10
	Red shiner	M A M J J A S O N D J F	12
	Redfin shiner	M A M J J A S O N D J F	12
	Suckermouth minnow	M A J J A S O N D J F	11
	Bluntnose minnow	M A M J J A S O N D J F	12
	Fathead minnow	S O	2
	Neosho Mt. minnow	M A M J J A S O N D J F	12
	Bullhead minnow	A A S O N D J F	8
Catfish	Black bullhead	S	1
	Channel catfish	J A S O N	5
	Stonecat	M A O	3
	Flathead catfish	A	1
	Brindled madtom	O N	2
	Freckled madtom	M A O N	4
Killifish	Blackband topminnow	A M J A S O N D F	9
Livebearer	Mosquitofish	M A M J J A S O N D J F	12
Silverside	Brook silversides	M A M J J A S O N D J F	12
Sunfish	Green sunfish	M A M J J A S O N D J F	12
	Orangespotted sunfish	M A M J J A S O N D J F	12
	Bluegill	A M J J A S O N D J F	11
	Longear sunfish	M A M J J A S O N D J F	12
	Spotted bass	A J J A S O N	7
	Largemouth bass	A	1
	White crappie	M J O	3
Perch	Orangethroat darter	M A J A S O N D J F	10
	Banded darter	M A M J S N	6
	Channel darter	A M	2
	Slenderhead darter	M A M J J A S O N D J F	12
	Logperch	M A M A S O N	7

Read table thus: The gizzard shad was collected in the months of April, May, June, July, August, September, October and December—a total of 8 months.

TABLE II. Dates of occurrence of 29 species of fishes in collections at Station I.

Common Family	Common Name	Mar.		April		May		June		July		Aug.		Sept.		Oct.		N. Dec.		Jan.		Feb.		Tot.
		13	20	27	3	10	16	23	8	23	29	6	12	19	2	10	17	23	30	13	17	8	29	
Gar	Longnose gar																							1
Herring	Gizzard shad										X													2
Sucker	Golden redborse																							1
	Shorthead redborse									X														2
	Suckermouth minnow																							5
	Redfin shiner																							17
	Red shiner																							29
	Bluntnose minnow																							12
	Mimic shiner																							6
Minnow	Ghost shiner																							15
	Neosho mt. minnow																							20
	Bluntnose minnow																							19
	Bullhead minnow																							10
	Fathead minnow																							1
	Stoneroller																							2
Catfish	Channel catfish																							8
	Freckled madtom																							6
	Brindled madtom																							3
Killifish	Blackband topminnow																							7
Livebearer	Mosquitofish																							13
Silverside	Brook silversides																							17
	Spotted bass																							12
Sunfish	Green sunfish																							21
	Bluegill																							5
	Orangespot'd sunfish																							16
	Longear sunfish																							23
Perch	Slenderhead darter																							10
	Logperch																							3
	Orangethroat darter																							14
	Collection Totals	5	10	6	9	9	14	3	3	1	4	15	2	4	3	4	6	8	9	13	11	15	15	300
	Monthly Totals	13						5	15	10	17	16	23	19	12	15								

TABLE III. Dates of occurrence of 27 species of fishes in collections at Station II.

Common Family	Common Name	Mar.			April			May			June			July			Aug.			Sept.			Oct.			Nov.			Dec.			Jan.			Feb.			Tot.	
		13	20	27	3	10	16	23	8	23	29	6	12	19	2	10	17	23	31	7	14	21	28	4	11	18	25	2	9	16	23	30	7	14	21	28	5		12
Gar	Longnose gar							x						x																								2	
	Gizzard shad							x																														6	
Herring	German carp										x																											1	
	Suckermouth minnow																																					17	
Minnow	Redfin shiner																																					10	
	Red shiner																																					20	
	Bluntnose minnow																																					23	
	Bluntnose minnow																																					2	
	Mimic shiner																																					1	
	Ghost shiner																																					1	
	Neosho m. minnow																																					6	
	Bluntnose minnow																																					19	
	Stoneroller																																					10	
	Flathead catfish																																					1	
Catfish	Stonecat																																					2	
Killifish	Blackband topminnow																																					12	
	Mosquitofish																																					4	
Livebearer	Brook silversides																																					15	
	Spotted bass																																					12	
Sunfish	Green sunfish																																					9	
	Bluegill																																					16	
	Orangespot'd sunfish																																					1	
	Longear sunfish																																					11	
Perch	Slenderhead darter																																					11	
	Channel darter																																					1	
	Logperch																																					10	
	Banded darter																																					8	
Orangethroat darter	Orangethroat darter																																					18	
	Collection Totals	6	7	7	6	10	6	2	5	10	10	9	4	8	5	7	8	2	6	6	13	7	18	11	9	13	7	10	10	3	6	7	3	7	3	2	5	2	5
Monthly Totals		13			13			13			14			13			15			18			15			18			10			7			7			5	

TABLE IV. Dates of occurrence of 31 species of fishes in collections at Station VIII.

Common Family	Common Name	Mar.		April		May		June		July		Aug.		Sept.		Oct.		N. Dec.		Jan.		Feb.		Tot.									
		13	20	27	3	10	16	23	8	23	29	2	10	17	23	31	7	14	21	18	25	2	16		23	30	3	17	8	29	12	26	
Gar	Longnose gar						X																	3									
	Gizzard shad						X																	6									
Herring	Bigmouth buffalo								X															1									
	Smallmouth buffalo								X	X														4									
Sucker	River carpsucker							X																2									
	Golden redhorse																X							2									
Sucker	Golden shiner							X																1									
	Suckermouth minnow								X															18									
Sucker	Redfin shiner							X	X															15									
	Red shiner							X	X	X														30									
Sucker	Bluniface minnow							X	X	X														5									
	Mimic shiner																							1									
Minnow	Ghost shiner							X	X															6									
	Bullhead minnow																							6									
Minnow	Neosho mt. minnow								X															14									
	Bluntnose minnow							X	X															19									
Minnow	Fathead minnow																							2									
	Stoneroller																							8									
Catfish	Black bullhead																							1									
	Stonecat																							1									
Livebearer	Mosquitofish																							18									
	Brook silversides																							4									
Sunfish	Spotted bass																							12									
	Green sunfish																							24									
Sunfish	Bluegill																							15									
	Orangespot'd sunfish																							26									
Sunfish	Longear sunfish																							8									
	White crappie																							1									
Perch	Slenderhead darter																							3									
	Logperch																							2									
Perch	Orangethroat darter																							1									
	Collection Totals	4	5	6	6	10	6	7	7	5	9	7	5	3	5	4	8	8	12	11	14	10	11	10	18	10	11	10	5	3	8	259	
Perch	Monthly Totals	8																							14	18	18	12	10	8			

TABLE V. Dates of occurrence of 31 species of fishes in collections at Station IX.

Common Family	Common Name	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	N. Dec.	Jan.	Feb.	Tot.
		13 20 27	3 10 16 23	8 23 29	6 12 19	2 10 17 23 31	7 14 21	18 25	2 16 23 30	3 17	8 29	12 26	
Gar	Longnose gar					x			x				1
	Gizzard shad		x	x					x				9
Sucker	Smallmouth buffalo			x					x				2
	River rehorse		x										1
	Suckermouth minnow	x	x	x	x	x	x	x	x	x	x	x	19
Minnow	Redfin shiner				x	x	x	x	x	x	x		13
	Red shiner	x	x	x	x	x	x	x	x	x	x	x	30
	Blunface minnow		x	x	x	x	x	x	x	x	x	x	13
	Mimic shiner	x	x	x	x	x	x	x	x	x	x	x	10
	Ghost shiner		x	x	x	x	x	x	x	x	x	x	8
	Bullhead minnow			x	x	x			x	x			2
	Bluntnose minnow	x	x		x	x				x	x		10
	Necoho mt. minnow	x	x			x		x			x		6
	Stoneroller	x	x			x		x					7
	Channel catfish						x						1
	Stonecat	x	x							x			3
	Killifish	Freckled madtom	x	x									
Blackband topminnow						x				x	x		4
Mosquitofish			x	x	x	x	x	x	x	x			14
Brook silversides		x	x		x		x				x		8
Sunfish	Spotted bass					x	x	x	x	x			12
	Largemouth bass						x						1
	Green sunfish	x	x	x	x	x	x	x	x	x	x	x	17
	Bluegill				x	x	x	x	x	x	x	x	8
	Orangespot'd sunfish	x	x	x	x		x	x	x	x			12
	Longear sunfish			x	x	x	x	x	x				12
	White crappie			x	x	x	x	x	x				4
Perch	Slenderhead darter	x	x		x		x	x	x	x			18
	Channel darter		x										1
	Logperch	x	x										4
Orangethroat darter	x	x		x		x						7	
Collection Totals	5 11 10	9 10 13	8 4 2 8	6 12 8 7 11	7 10 8 14 12 10 6 12 8 15	9 10 11 7 11 7 10 8 14 12 10 6 12 8 15	18 18	15 15	19 19	9 10 10	6 6 6 6 1 1 4	1 1 4	259
Monthly Totals	15	22	10	16	18	18	18	15	19	9	10	7	4

The golden shiner was present in collections at Station VIII only on May 8.

Phenacobius mirabilis (Girard)—plains suckermouth minnow

Suckermouth minnows were present in all months of collection excepting May and were characteristic of spring, fall, and winter collections. It was taken in 59 collections, but occurred in only the June 19 collection at Station I, the June 12 and July 10 and 31 collections at Station VIII, and the June 19 and July 23 and 30 collections at Station IX. In general, this species was present in collections from March 13 to April 16 and from August 7 to February 26.

Notropis umbratilis umbratilis (Girard)—southern redbfin shiner

The redbfin shiner occurred in collections for all months of the study. No obvious trends in seasonal variation of the 55 occurrences in collections were noted.

Notropis lutrensis Baird and Girard—red shiner

This species appeared in collections at all stations for all months with the exception of Station II, where it was not collected in October. Seasonal variation was not expected since red shiners were present in 109 of the 131 collections.

Notropis camura (Jordan and Meek)—bluntnose minnow

With the exception of January and February, bluntnose minnows were present in collections during all months. It was taken in 52 collections from April 3 to December 17 at all stations, and in one collection on March 27 at Station II.

Notropis volucella (Cope)—mimic shiner

Mimic shiners were only absent from January and February collections. Seasonal variation was noted in the 19 occurrences in collections at the 4 stations. At Station I, it occurred 6 times in June, August, October, and December collections. It was present in the June 19 and July 10 collections at Station II. At Station VIII, it was recorded only in the August 21 collection. It was taken 10 times at Station IX and in all months but June, January, and February.

Notropis buchanani Meek—ghost shiner

Ghost shiners did not occur in collections in August and September of the 12-month study. One-half of the 30 occurrences in collections were in the period from March 13 to July 10 at all 4 stations. The remaining 15 occurrences were recorded in collections from October 2 to February 26 at Stations I, VIII, and IX; 11 of these appeared in consecutive collections at Station I.

Pimephales viviflax perspicuus (Girard)—bullhead minnow

Bullhead minnows were not present in March, May, June, and July collections. This species seemed to be a fall and winter species: 16 of the

18 occurrences in collections were recorded after August 21 at Stations I, VIII, and IX. Two exceptions were the April 10 collection at Station I and the April 16 collection at Station VIII. It was not present in collections at Station II.

Pimephales tenellus tenellus (Girard)—Neosho mountain minnow

The Neosho mountain minnow was present in collections from all months. With the exception of 2 collections recorded in the period from July 2 to August 14 at Stations I and IX, 44 of the 46 occurrences were from March 13 to June 19 and from August 21 to February 26.

Pimephales notatus (Rafinesque)—bluntnose minnow

Bluntnose minnows were present in collections from all months. With 2 exceptions, this species was taken in 67 collections during 2 periods—March 13 to June 19, and August 14 to February 26. The 2 exceptions were the July 23 collection at Station VIII and the July 2 collection at Station IX.

Pimephales promelas (Rafinesque)—fathead minnow

The fathead minnow was present in collections at Station VIII, on 2 consecutive dates, September 25 and October 2. It was taken on one other occasion only, June 19 at Station I.

Campostoma anomalum pullum (Agassiz)—central stoneroller

With the exception of May, stonerollers were present in 9 of the 10 months of collection from March to December. Nine of the 27 occurrences in collections were from March 13 to April 16 at Stations II, VIII, and IX, and the remaining 18 occurrences were in the collections from June 6 to December 17 at all stations.

Family Ameiuridae, catfishes

Catfishes were present in collections from 7 months—March and April and July through November—and were represented by 6 species.

Ictalurus punctatus (Rafinesque)—channel catfish

Seasonal variation in the 9 occurrences of channel catfishes at Stations I and IX was noted; the species was not collected at Stations II and VIII. It was present in 8 of the 12 collections from July 23 to November 13 at Station I, and occurred in the August 7 collection at Station IX.

Ameiurus melas (Rafinesque)—black bullhead

Black bullheads appeared in the September 25 collection only at Station VIII.

Pilodictis olivaris (Rafinesque)—flathead catfish

Flathead catfish represented by one young-of-the-year were present only in the August 14 collection at Station II.

Noturus flavus (Rafinesque)—stonecat

Stonecats were collected in 3 months only—March, April, and October. The species occurred in collections on March 12 and 20 at Sta-

tion II; on April 16 at Station VIII; and on March 20, April 10 and October 30 at Station IX. It was not recorded in collections from Station I.

Schilbeodes nocturnus (Jordan and Gilbert)—freckled madtom

Freckled madtoms were collected in March, April, October, and November. The species was not collected at Stations II and VIII. At Station I, freckled madtoms were present in collections on March 20; April 10; October 2, 16, and 30 and November 13. It was collected on March 20 and April 10 at Station IX.

Schilbeodes miurus (Jordan)—brindled madtom

This species was present in collections at Station I only on October 2 and 16 and November 13.

Family Cyprinodontidae, killifishes

Fundulus notatus (Rafinesque)—blackband topminnow

Blackband topminnows, the only cyprinodontid representative, appeared in collections from all months but March, June, and January. Seventeen of the 23 occurrences in collections were in the period from July 23 to November 13. The six exceptions were the April 16 and February 26 collections at Station I, the May 23 and 29 collections at Station II, and the July 2 and December 3 collections at Station IX. This species was not collected at Station VIII.

Family Poeciliidae, livebearers

Gambusia affinis (Baird and Girard)—mosquitofish

The only poeciliid representative, the western mosquitofish, was taken in 49 collections and in all months. Of these collections, 7 were recorded in the period from March 27 to May 23 at Stations VIII and IX, 34 were recorded from June 6 to November 13 at all 4 stations, and 8 were recorded at Stations I and VIII from December 3 to February 26.

Family Atherinidae, silversides

Labidesthes sicculus (Cope)—brook silversides

Atherinids represented by the northern brook silversides were present in collections from all months. The species occurred in 44 collections. From March 20 to April 16, it was collected 7 times at Stations I, II, and IX; 6 times from May 23 to July 17 at Stations II and IX; and 31 times from July 31 to February 26 at all 4 stations.

Family Centrarchidae, sunfishes

The months collection of 6 species of centrarchids varied for individual species. Green sunfish, orangespotted sunfish, and longear sunfish were present in collections of all months. Bluegill were taken every month, excepting March. Spotted Bass occurred in April and in collections from July to November. White crappie was present in May, June, and October collections and the largemouth bass was taken in August, only.

Micropterus punctulatus punctulatus (Rafinesque)—northern spotted bass

Spotted bass was taken in seven months—April and June through November. From June 19 to November 13, 47 of the 48 collections occurred at all 4 stations, the exception being the April 16 collection at Station IX.

Micropterus salmoides salmoides (Lacépède)—northern largemouth bass

One adult largemouth bass appeared in the August 21 collection at Station IX.

Lepomis cyanellus (Rafinesque)—green sunfish

Green sunfish occurred in 71 collections in all months of the year. Seasonal variation was noted only at Station II where the species was least frequently collected. Three of the 9 occurrences in collections were from March 27 to April 16, and the remaining 6 were taken or collected from August 14 to December 17.

Lepomis macrochirus (Rafinesque)—bluegill

Although bluegill were present in collections in all months with the exception of March, 36 of the 44 occurrences in collections were in the period from August 7 to February 26 at all stations. Its 8 remaining collections were made from April 3 to July 23.

Lepomis humilis (Girard)—orangespotted sunfish

The orangespotted sunfish was taken in 44 collections and in all months of the study. Different seasonal variation patterns were noted at the 4 stations. At Station I, the species appeared in 3 of the 5 collections from March 20 to April 16 and in 13 of the 15 collections from August 14 to February 26. The species was recorded from the October 2 collection only at Station II. It was present in 26 of the 33 collections at Station VIII, where 4 of the 7 collections from which it was not recorded were in July. At Station IX, 6 occurrences were recorded from March 20 to June 19 and 6 from September 18 to November 13.

Lepomis megalotis (Rafinesque)—longear sunfish

Longear sunfish were taken in 54 collections in all 12 months of the study. At Station I, the 23 occurrences in collections were recorded in all months but May and December. Only 3 of the 11 occurrences in collections at Station II were recorded from April 3 to July 17, while the remaining 8 occurred from August 7 to December 17. The 8 occurrences in Station VIII collections were recorded in July, October, November, and February. At Station IX, it occurred in 12 collections in the 7 months from April to October.

Pomoxis annularis (Rafinesque)—white crappie

White crappie occurred in May, June, and October collections. The species was present in the October 16 collection at Station VIII. At Station IX collections, 4 occurrences were in May and June. The species was not collected at Stations I and II.

Family Percidae, perches

Considerable variation in the occurrence of the 5 species of percids was noted in collections. In general, percids were not present in collections during summer months, and only one species, the slenderhead darter, was taken in July collections.

Hadropterus phoxocephalus (Nelson)—slenderhead darter

The slenderhead darter was the only percid which was collected in all months of the study. The species occurred in 42 collections. At Stations I, II, and IX, 19 occurrences in collections were recorded from March 13 to June 19. At Station IX, 2 July occurrences were recorded. From August 7 to February 26, it was collected 21 times at all 4 stations.

Hadropterus copelandi (Jordan)—channel darter

The river darter appeared in the May 29 collection at Station II and in the April 16 collection at Station IX, only.

Percina caprodes (Rafinesque)—logperch

The longperch was characteristic of spring and fall collections. It occurred in collections from March to June and from August to November. Twelve of the 19 occurrences in collections were recorded from March 27 to June 19 at Stations I, II, and IX. It occurred in 7 collections from August 14 to November 13 at Stations I, II, and VIII.

Etheostoma zonale arcansum (Jordan and Gilbert)—Arkansas banded darter.

The banded darter occurred only in collections at Station II. It was collected from March 13 to June 6 and on September 18 and 25 and on November 13.

Etheostoma spectabile pulchellum (Girard)—plains orangethroat darter

The orangethroat darter was present in 40 collections from all months, excepting May and July. It occurred in 12 collections from March 13 to April 17 at Stations I, II, and IX. Two occurrences in collections from May, June, and July were recorded on June 19 at Stations I and IX. At all stations, it occurred in 26 collections from August 14 to February 26.

TRENDS IN NUMBER OF SPECIES IN COLLECTIONS

This discussion of trends in the number of species in monthly collections at each of the 4 stations is based on the number of species in monthly collections and on the cumulative totals of the number of species. The cumulative total is the number of different species which had been collected up to a certain time.

Station I

At least 51.7 per cent (15 species) of the 29 species which were collected at Station I were present in 7 different monthly collections (Table

VI). In March, May, July, December, and January, no more than 44.8 per cent (13 species) of the 29 species occurred in collections. The percentage of the 29 species in monthly collections varied from 17.2 per cent (5 species) in May to 79.3 per cent (23 species) in October.

TABLE VI. Number, cumulative totals, and percentages of 29 species of fishes in month collections at Station I.

Month	Number of Species	Per cent of Total Number	Cumulative Total	Cumulative Per cent
March	13	44.8	13	44.8
April	17	58.6	19	65.5
May	5	17.2	19	65.5
June	15	51.7	23	79.3
July	10	34.5	27	93.1
August	17	58.6	28	96.6
September	16	55.2	28	96.6
October	23	79.3	29	100.0
November	19	65.5	29	100.0
December	12	41.4	29	100.0
January	12	41.4	29	100.0
February	15	51.7	29	100.0

Eight months of collection, March to October, were needed to complete the check list of 29 species at Station I (Table VI). After 13 species were collected in March, the cumulative total of species was increased to 19 in April. Five species which were present in May collections added no species to the cumulative total. The cumulative total of species reached 27 when 8 species, which had not been collected previously, were present in June and July collections. Three more months of collections, August, September, and October, were needed to collect the 28th and 29th species. No species was added to the cumulative total during the last 4 months of collection, November to February.

Station II

In 8 different months of the study, 13 species (48.1 per cent), or less of the 27 species which were collected at Station II were present in the collections (Table VII). In the other 4 months (June, August, September, and October) of the study, more than 14 species (51.9 per cent) of the 27 species were collected. In monthly collections, the percentages of the 27 species varied from 5 species (18.5 per cent) in February to 18 species (66.7 per cent) in September.

It was not until 8 months of collecting was completed in October that the cumulative total of 27 species was attained (Table VII). Thirteen species were collected in the first month, March. The cumulative total of species was increased to 21 with the addition of 3 species in April and 5

TABLE VII. Numbers, cumulative totals, and percentages of 27 species of fishes in monthly collections at Station II.

Month	Number of Species	Per cent of Total Number	Cumulative Total	Cumulative Per cent
March	13	48.1	13	48.1
April	13	48.1	16	59.3
May	13	48.1	21	77.8
June	14	51.9	23	85.2
July	13	48.1	24	88.9
August	15	55.5	25	92.6
September	18	66.7	26	96.3
October	15	55.5	27	100.0
November	10	37.0	27	100.0
December	7	25.9	27	100.0
January	7	25.9	27	100.0
February	5	18.5	27	100.0

species in May. Only 6 more species were added during the next 5 months, June to October, when the cumulative number reached 27.

Station VIII

A total of 31 species were collected at Station VIII (Table VIII). In general, the percentages of the 31 species present in the collections of each month at Station VIII were less than at any of the other stations. With the exception of October and November, when 18 species (58.1 per cent) of the 31 species were taken, not more than 15 species (48.4 per cent) of the 31 species were taken in any other one of the 10 months. The smallest percentage, which was 8 species (25.8 per cent) of the 31 species, was collected in both March and February.

TABLE VIII. Numbers, cumulative totals, and percentages of 31 species of fishes in monthly collections at Station VIII.

Month	Number of Species	Per cent of Total Number	Cumulative Total	Cumulative Per cent
March	8	25.8	8	25.8
April	11	35.5	13	42.0
May	11	35.5	17	54.8
June	13	42.0	21	67.7
July	14	45.2	23	74.2
August	15	48.4	24	77.4
September	14	45.2	25	80.6
October	18	58.1	30	96.8
November	18	58.1	30	96.8
December	12	38.7	30	96.8
January	10	32.3	30	96.8
February	8	25.8	31	100.0

A total of 31 species were collected at Station VIII, but it required 12 months to collect all 31 species (Table VIII). Only 8 months of

collection were required to collect all the species at the other 3 stations; 8 species were collected at Station VIII in March. In the next 3 months, April to June, 13 species which had not been collected previously increased the cumulative total to 21. Four additional species in July, August, and September brought the cumulative total to 25. In October, the addition of 5 species increased the cumulative total to 30. Additional species were not present in November, December, and January collections. One of the 8 species which was collected in February, the last month of the study, brought the cumulative total to 31 species.

Station IX

At Station IX, 16 species (51.6 per cent) of the 31 species were recorded in April, June, July, August, and October, only (Table IX). The largest percentage of species was present in collections from March to October, when in all the months (with the exception of May) 15 species (more than 48.4 per cent) of the 31 species were recorded. In the 5 remaining months, May and November to February, 10 species (less than 32.3 per cent) of the 31 species occurred in collections. The percentage of the 31 species in collections ranged from 12.9 per cent (4 species) in February to 71.0 per cent (22 species) in October.

The cumulative total of 31 species was attained after 8 months of collection at Station IX. Fifteen species were present in March, the first month of collection. April and May collections added 10 species to increase the cumulative total to 25. In the next 5 months, June to October, 6 additional species brought the cumulative total to 31 species. During the last 4 months of the study, no more species were added to the total number.

TABLE IX. Number, cumulative totals, and percentages of 31 species of fishes in monthly collections at Station IX.

Month	Number of Species	Per cent of Total Number	Cumulative Total	Cumulative Per cent
March	15	48.4	15	48.4
April	22	71.0	22	71.0
May	10	32.3	25	80.6
June	16	51.6	25	80.6
July	18	58.1	28	90.3
August	18	58.1	30	96.8
September	15	48.4	30	96.8
October	19	61.3	31	100.0
November	9	29.0	31	100.0
December	10	32.3	31	100.0
January	7	22.6	31	100.0
February	4	12.9	31	100.0

In Table X, the numbers and cumulative totals of the 42 species present in all collections at the 4 stations are tabulated. In 8 months, 24 species (more than 57.1 per cent) of the 42 species were collected. During the other 4 months, March, December, January, and February, 20 species (less than 47.6 per cent) of the 42 species occurred in collections. The percentages of the 42 species in each monthly collection varied from 35.7 per cent (15 species) in January to 69.0 per cent (29 species) in October.

TABLE X. Numbers, cumulative totals, and percentages of 42 species of fishes in monthly collections at Stations I, II, VIII, and IX.

Month	Number of Species	Per cent of Total Number	Cumulative Total	Cumulative Per cent
March	20	47.6	20	47.6
April	28	66.7	28	66.7
May	24	57.1	33	78.6
June	24	57.1	34	81.0
July	24	57.1	36	85.7
August	24	57.1	38	90.5
September	27	64.3	41	97.6
October	29	69.0	42	100.0
November	26	61.9	42	100.0
December	20	47.6	42	100.0
January	15	35.7	42	100.0
February	16	38.1	42	100.0

From collection at all 4 stations, 20 species (more than 47.6 per cent) of the 42 species were present in 10 months. Of the 42 species, 15 species (35.7 per cent) and 16 species (38.1 per cent) occurred in January and February collections, respectively. The greatest percentage, 69.0 per cent (29 species) of the 42 species, was collected in October.

Although 28 species (66.7 per cent) of the 42 species were collected in the first 2 months of the study, 8 months of collections were required before all 42 species were collected (Table X). During March, the first month of the study, 20 species (47.6 per cent) of the 42 species were present in collections. The cumulative percentage was increased to 78.6 per cent (33 species) of the 42 species in the next 2 months with 8 species added to the cumulative total in the next 5 months, June to October. No additional species was recorded during the last 4 months of collection at the 4 stations.

SUMMARY

1. A year-round study was made of the fishes in the Fall and Verdigris rivers in Wilson and Montgomery counties, Kansas. Thirty-four collections were made at each of 4 stations during the 12 months.

2. A checklist of 42 species of fishes in 10 families was compiled.

3. The number of species in the 10 families were minnows 13; sunfishes 7; catfishes 6; suckers 6; perches 5; and one each of gars, herrings, livebearers, killifishes, and silversides.

4. The numbers of species which were collected at Stations I, II, VIII, and IX were 29, 27, 31, and 31, respectively. At Stations I, II, and IX, no new species were collected after the 8th month. At Station VIII, one new species was found in the 12th month of collection.

5. Of the 42 species collected at all stations 20 (47.6 per cent) were present in collections in 10 of the 12 months.

6. Of the 29 species collected at Station I, 15 species (51.7 per cent) were present in collections in 7 of the 12 months; at Station II, 15 out of 27 species (48.2 per cent) were present in collections in only 3 of the 12 months; at Station VIII, 15 of 31 species (48.4 per cent) were present in collections in only 3 of the 12 months; at Station IX, 15 of 31 species (48.4 per cent) were present in collections in 7 of the 12 months.

7. In general, darters were not collected during June, July, and August when water temperatures were high. The orangethroat darter was collected least frequently when water temperatures exceeded 22.6°C.

8. The occurrences of channel catfish, flathead catfish, spotted bass, and longnose gar in collections were seasonal.

9. The 42 species of fishes were listed by the seasons in which they occurred in collections. Only 7 species occurred in all 4 seasons or were year around species. Twenty-five of the 42 species were not collected in more than 2 seasons of the year.

10. Darters were collected more frequently in the clearer water of the Fall River. In the Verdigris River, where the variations in discharge and turbidity were greater, sunfish were collected more frequently. Suckers were not collected in the Fall River. Three of the 42 species of fishes were collected in the Fall River which were not collected in the Verdigris.

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