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Steven R. Walker
University of Nebraska-Lincoln

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DISTRIBUTION OF FISHES IN THIRTY-TWO MILE CREEK, NEBRASKA

Steven R. Walker

Department of Forestry, Fisheries, and Wildlife
University of Nebraska-Lincoln
Lincoln, Nebraska 68583

Thirty-two Mile Creek drains a 276 km^2 area in south central Nebraska as a tributary to the Little Blue River. Fishes were collected during the summer of 1977 using a seine. Nine species were collected at the 16 stations sampled.

The fathead minnow (*Pimephales promelas*) was the most abundant species and present at every station. Black bullhead (*Ictalurus melas*), carp (*Cyprinus carpio*), and red shiner (*Notropis lutrensis*) were widespread while other species had limited distributions. Species diversity was determined for each station and stream order. Fish distribution and abundance in the drainage were affected by a recent dam and other environmental factors.

Measurements of physical parameters such as water temperature, depth, current velocity, substrate composition, turbidity, and abundance of cover provided insights for analysis of species' habitat requirements.

† † †

INTRODUCTION

Surveys of fish distribution are important in determining recreational potential of streams. Species of fish present in a stream can also be useful indicators of water quality. Prior to this study, little was known about the fish species of Thirty-two Mile Creek. Objectives of this research were to determine the fish species present in Thirty-two Mile Creek, obtain information on the distribution and abundance of each species, and measure physical properties of the stream to determine species' habitat preferences.

STUDY AREA

Thirty-two Mile Creek is one of the largest tributaries in the headwater region of the Little Blue River. It is a turbid stream located in Adams County, Nebraska, composed of two large tributaries that drain 142 km^2 and 77 km^2 areas respectively, and join 11.3 km above the creek's entry into the Little Blue River. A drop in elevation of 61 m occurs from the headwaters to the mouth of the creek. Flood-control dams are located on the two large tributaries and on four small tributaries not shown on road maps (Fig. 1).

Annual precipitation in this watershed is about 61 cm and usually occurs from high-intensity, short-duration storms. Flooding occurs occasionally in lowland areas because of the small capacity of the creek channel (Anonymous, 1965). Soils of this drainage are primarily silt loams. Land use practices are farming and livestock production (Ragon, 1974).

METHODS

The 16 sampling stations on Thirty-two Mile Creek were uniformly distributed. Some areas of the creek designated as stations prior to the start of this study could not be sampled because of flow levels or accessibility to these sites. An attempt was made at each station to sample all habitat types in a 61 m (200 ft) section. Sampling was continued until no new species was collected after three or four consecutive sweeps over the same habitat areas. A 0.64 cm mesh seine, 2.74 m long and 1.22 m deep, was used to sample fishes.

Most fishes collected were preserved in 10% formaldehyde. Some ictalurids that were easily identified in the field were measured and released. Generally, all cyprinids were kept because of difficulty in distinguishing between species in the field. Identification and measurement of total length were accomplished later in the laboratory. Photographs of each station and of areas where fish populations could be affected were taken with a pocket instamatic camera. These were attached to stream survey cards and provided visual information of habitats present at each station.

Data collected at each station included air temperature, water temperature, weather conditions, average width and depth, deepest hole, cover, turbidity, substrate composition,

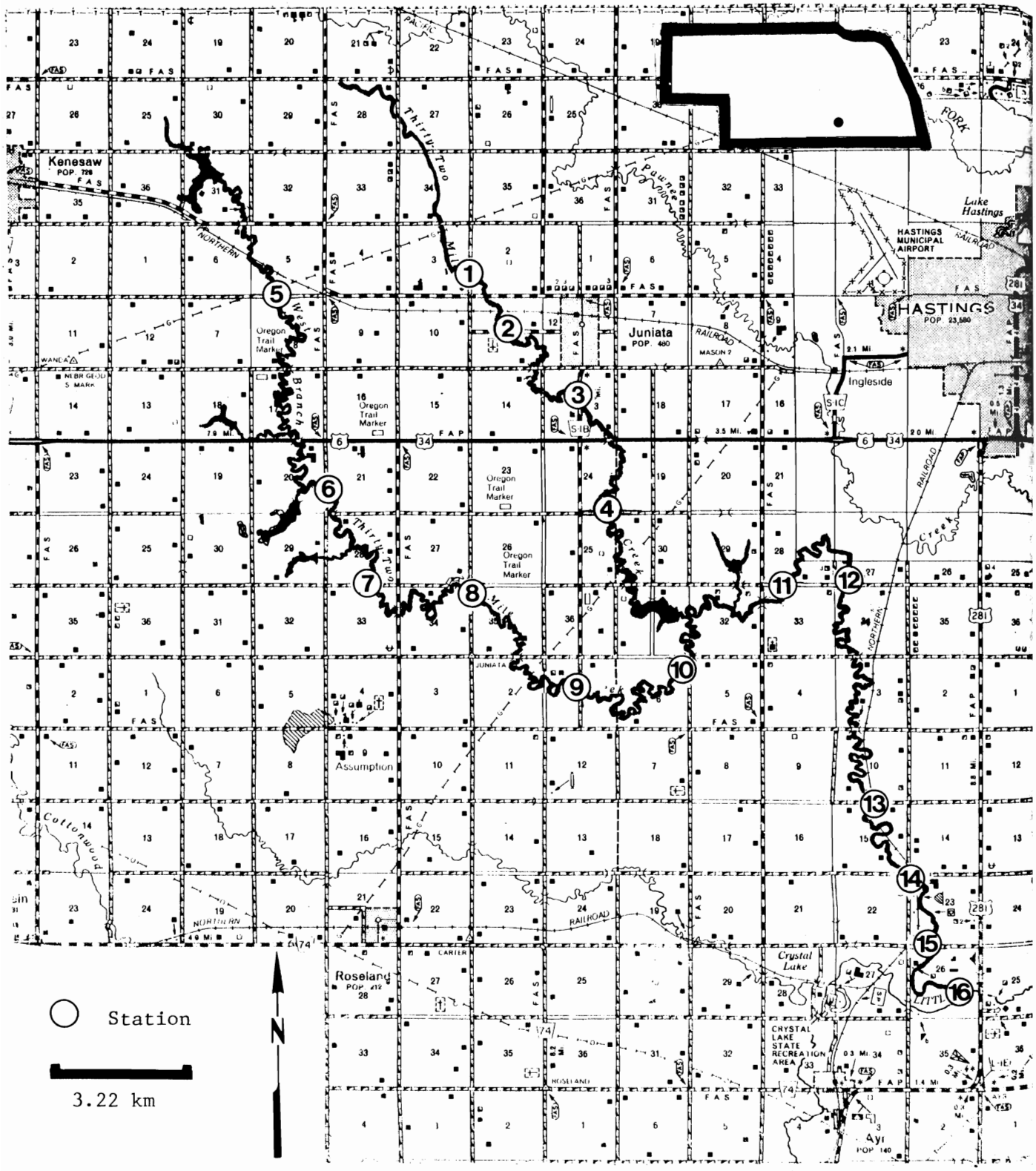

FIGURE 1. Location of flood-control dams and sampling stations on Thirty-two Mile Creek, 1977.

current velocity, and percentage of riffle and pool area. Water temperatures were measured by submerging a thermometer for 5 min just below the surface of the creek at an area of average depth. Air temperature was measured along the creek bank in the shade. Current velocity was measured by dropping small floating objects into the creek and measuring with a stopwatch the time required for them to travel a known distance.

Turbidity was recorded as muddy, murky, moderately turbid, or slightly turbid, using visual observations. The following criteria were used to measure turbidity: **muddy**, clouds of sediment present throughout the water, hand visible at water surface only; **murky**, water brown but clouds of sediment not prominent, hand visible just below water surface; **moderately turbid**, hand visible a minimum of 10 cm below water surface; **slightly turbid**, hand visible a minimum of 30 cm below water surface. This procedure is a relative measure but provides a description of the creek at time of sampling that could not be obtained with a listing of suspended solids in parts per million. Application of this method is of practical use when some information on turbidity is desired but precise measurement is unnecessary.

Horton's (1945) stream-order classification, as modified by Strahler (1954, 1957) was used to identify the streams of Thirty-two Mile Creek. Species diversity (d) was determined for each station and stream order, by the equation, $d = s - 1 / \ln N$, which expresses the relationship between the total number of species (s) and the natural logarithm (ln) of the total number of individuals (N) (Margalef, 1958).

RESULTS AND DISCUSSION

Sample Stations

The stream survey of Thirty-two Mile Creek took place during the summer of 1977. Sixteen stations were sampled. The exact location of each station is shown in Figure 1. Three families and nine species of fish were represented in collections made during this study (Table I).

Two stream types are present in Thirty-two Mile Creek: very turbid, mud-bottom stream, usually 1 m to 3 m wide; and slightly turbid, sand, gravel and rock-bottom stream, 2 m to 5 m wide. The latter stream occurs at the lower 4.8 km of the creek (stations 13-16). Physical habitats present at each station are shown in Table II. Two stream orders are present in the creek. The two large tributaries are first-order streams and they join forming a second-order stream which flows into the Little Blue River.

TABLE I. Common and scientific names, relative abundance, distribution, and composition of the fishes collected in Thirty-two Mile Creek, 1977.

Species	Common Name	Total Collected	No. of Stations	Fish Composition %
Family Cyprinidae				
Cyprinus carpio	Carp	17	9	4.2
Notropis lutrensis	Red shiner	94	9	23.3
Notropis stramineus	Sand shiner	74	4	18.3
Phenacobius mirabilis	Suckermouth minnow	8	2	2.0
Pimephales promelas	Fathead minnow	163	16	40.4
Semotilus atromaculatus	Creek chub	1	1	0.2
Family Ictaluridae				
Ictalurus melas	Black bullhead	26	11	6.4
Ictalurus punctatus	Channel catfish	20	7	5.0
Family Centrarchidae				
Lepomis cyanellus	Green sunfish	1	1	0.2

TABLE II. Physical habitats at each sample station, 1977.

Station Number & Date Sampled	Average Depth (cm)	Average Width (m)	Deepest Hole (cm)	Pool: Riffle	Turbidity	Substrate	Current Velocity m/sec	Water ^{o}C Temperature	Cover
1 May 22	38	0.9	81.3	9:1	murky	mud	0.014	18.9	some vegetation
2 June 11	46	13.0	61.0	10:0	muddy	mud	0.000	15.5	minimal
3 June 11	41	1.8	55.9	10:0	murky green	mud	0.000	15.5	some small tree stumps
4 June 25	13	1.7	61.0	9:1	murky	mud	0.57	30.5	minimal
5 Aug. 12	23	0.9	91.4	8:2	murky	mud	0.027	23.3	some vegetation
6 July 5	58	3.0	91.4	9:1	murky	mud	0.08	25.0	some brush
7 July 5	18	1.8	22.9	9:1	murky	mud	0.60	27.2	some logs and brus
8 July 12	61	1.8	71.1	10:0	murky	mud	0.20	24.4	some small tree stumps
9 July 8	33	2.4	76.2	7:3	mod. turbid	mud	0.44	25.0	lots of wire, brush and logs
10 July 12	64	3.4	86.4	10:0	murky	mud	0.33	25.0	some vegetation
11 Aug. 12	51	3.0	63.5	10:0	murky	mud	0.44	24.4	some logs, brush a vegetation
12 June 18	28	2.7	43.2	10:0	muddy	mud	0.44	21.1	some logs and brus
13 Aug. 13	30	2.5	71.1	2:8	slightly turbid	gravel/mud /rock	0.40	23.3	large rocks in pool
14 Aug. 1	36	3.7	61.0	2:8	mod. turbid	sand/gravel /rock	0.50	24.4	some brush
15 Aug. 1	20	4.6	35.6	4:6	slightly turbid	sand/gravel	0.50	24.4	some brush
16 Aug. 1	25	2.4	53.3	1:9	slightly turbid	sand/gravel /rock	0.80	24.4	some rocks

Annotated List of Species

In this list, the scientific name of each species is followed by the common name, as listed by Bailey *et al.* (1970), and the stations where the species were collected. The families of fishes are arranged in phylogenetic sequence, following the classification proposed by Greenwood *et al.* (1966). Within each family, however, genera and species are listed alphabetically. Specimens will be stored in the University of Nebraska State Museum, Lincoln.

Cyprinus carpio (Linnaeus), carp. Stations 1, 2, 4, 5, 6, 9, 11, 12, and 13. The largest carp sampled measured 101 mm in total length. All carp collected were seined from mud-bottomed pools with muddy or murky turbidities. Their occurrence in pools seemed to indicate a preference for little or no current. Carp tolerance was demonstrated by collections from residual pools, and in water temperatures ranging from 15.5 C to 30.5 C. Hard substrates, riffles, and swift currents were avoided by carp.

Notropis lutrensis (Baird and Girard), red shiner. Stations 6, 9, 10, 11, 12, 13, 14, 15, and 16. The largest red shiner collected measured 65 mm in total length. Habitat preferences were riffles, swift current, moderate to slight turbidities, coarse substrate, and good discharge. Red shiners were not present at stations with average depths less than 20 cm or those at which cattle had access to the creek. Preference of red shiners in Thirty-two Mile Creek for riffles, instead of pools, is contrary to most previous descriptions of their preferred habitat. Deacon (1961), however, suggested that red shiners may be periodically abundant in riffles when they are almost unoccupied by other fish species. Water temperature may also be a factor in the distribution and abundance of red shiners. All red shiner collections were made in water between 21 C and 25 C. In general, it seems that red shiners avoided residual pools, polluted waters, temperature extremes, and shallow depths.

Notropis stramineus (Cope), sand shiner. Stations 13, 14, 15, and 16. Habitat preferences were coarse substrate, swift current, and slight to moderate turbidity. No sand shiner was collected over a mud substrate, and most were collected from riffles. The largest sand shiner sampled measured 63 mm in total length. Sand shiners were collected at all four of the stations on Thirty-two Mile Creek that had coarse substrates.

Phenacobius mirabilis (Girard), suckermouth minnow. Stations 13 and 14. A preference was shown for sand, gravel, and rock substrate, large areas of riffles (greater than 60%), and moderate current (0.4 to 0.5 m/sec). Avoidance of areas with steep gradients, swift current (greater than 0.7 m/sec), and shallow average depths (less than 20 cm), was suggested by collection efforts. The largest suckermouth minnow sampled measured 95 mm in total length.

Pimephales promelas (Rafinesque), fathead minnow. Stations 1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, and 16. The fathead minnow was found at every station and was the most abundant species in Thirty-two Mile Creek. The largest fathead minnow collected measured 72 mm in total length. Fathead minnows showed a preference for mud bottoms, pools, and little or no current. They were abundant in areas where few other species were present. A preference was shown for muddy or murky turbidities, but fathead minnows were found in abundance also at two gravel-bottom stations having slight turbidities. The most notable preference of fathead minnows was for pools instead of riffles.

Semotilus atromaculatus (Mitchell), creek chub. Station 15. A single individual, 90 mm in total length, was collected. This specimen was collected over a sand-and-gravel substrate, in moderate current (0.5 m/sec) next to a brush pile.

Ictalurus melas (Rafinesque), black bullhead. Stations 3, 4, 5, 6, 7, 8, 9, 10, 11, 13, and 14. The largest fish sampled during this study was a black bullhead 170 mm in total length. Black bullheads were collected exclusively in pools, which suggests a preference for quiet water. Black bullheads also preferred mud bottoms and muddy to murky turbidities.

Ictalurus punctatus (Rafinesque), channel catfish. Stations 5, 8, 11, 13, 14, 15, and 16. The largest channel catfish collected measured 96 mm in total length and was one year old. Age was determined by counting annuli on pectoral spine sections cut by a small, power saw and examined microscopically. No general habitat trends were observed for age 0 and age 1 channel catfish. Collections were made over sand, gravel, rock, and mud substrates; in riffles and pools; and in varying turbidities and current velocities.

Lepomis cyanellus (Rafinesque), green sunfish. Station 2. Only one individual, 101 mm in total length, was collected. The creek was dry above and below this station. The habitat consisted of a long, moderately deep, residual pool (average depth 60 cm), with a mud substrate, and muddy turbidity.

Factors Influencing Species Abundance and Distribution

Habitat preferences of fish species will affect their abundance in different stream types. Table III shows species diversity and distribution of fishes in Thirty-two Mile Creek for each station and order of stream. The numbers of each species collected at each station are listed. Harrel *et al.* (1967) noted an increase in species diversity with stream order and attributed this to an increase in available habitat and decrease in environmental fluctuations with increasing stream order. Odum *et al.* (1960) postulated that fishes found in low-order streams had more generalized habitat requirements than those restricted to higher-order streams.

TABLE III. Distribution and species diversity of fishes in Thirty-two Mile Creek, 1977.

Species	Station Number	First-order Streams										Second-order Streams					
		1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
	Number Collected																
Cyprinus carpio		1	2		1	4	3			1		2	2	1			
Notropis lutrensis							6			1	1	2	2	15	18	13	36
Notropis stramineus														11	16	9	38
Phenacobius mirabilis														6	2		
Pimephales promelas		27	13	4	6	5	10	10	4	2	18	9	2	14	9	22	2
Semotilus atromaculatus																1	
Ictalurus melas				1	5	3	2	4	3	1	2	2		2	1		
Ictalurus punctatus						3			6			2		4	2	2	1
Lepomis cyanellus			1														
Total individuals		28	16	5	12	15	21	14	13	5	21	17	6	53	48	47	77
Total species		2	3	2	3	4	4	2	3	4	3	5	3	7	6	5	4
Species diversity		0.30	0.72	0.62	0.80	1.11	0.99	0.38	0.78	1.86	0.66	1.41	1.12	1.51	1.29	1.04	0.69
Combined N		150										248					
Combined s		6										8					
Combined d		1.00										1.27					

The second-order stream of Thirty-two Mile Creek had greater abundance of fishes, more species, and a larger diversity index than the first-order streams. Species collected in the latter were generally highly tolerant, mobile species adapted to intermittent stream conditions. These findings compare favorably with those of Harrel *et al.* (1967) and Odum *et al.* (1960).

Relative abundance of each species, number of stations where collections were made, and the fish composition of Thirty-two Mile Creek are shown in Table I. Species abundance and distribution varied throughout Thirty-two Mile Creek and could be classified: (1) widespread, sometimes abundant; (2) widespread, never abundant; (3) limited distribution, always abundant; and (4) limited distribution, never abundant. Abundant species in this classification were those with 9 or more specimens collected at a station. Widespread species were those found at 8 or more of the 16 stations. Red shiner and fathead minnow were characterized by classification 1; carp and black bullhead by classification 2; sand shiner by classification 3; and channel catfish, suckermouth minnow, green sunfish, and creek chub by classification 4.

Game fish collected in Thirty-two Mile Creek were channel catfish and black bullhead. Only one specimen, a black bullhead, was of a "keepable size." The only possibility for a fishery within this drainage would seem to be the lakes formed by flood-control dams.

Annual cycles of abundance of small fishes have been noted by many authors (Wickliff, 1941; Larimore, 1955; Paloumpis, 1958a,b). Nearly all studies have shown populations are high in summer and fall. Published information on spring populations is contradictory, some authors noting high and others low levels during this season. Differences in spring populations may depend upon whether the streams stayed open during the winter. A stream that stayed open all winter would have a higher spring population than a stream that had frozen over during the winter and had to be repopulated.

Smith (1963) stated that increases in late summer and fall are due, in part, to the appearance of young-of-the-year in many cyprinid species. This trend was evident in Thirty-two Mile Creek. Cyprinids with breeding characteristics were collected during each month of the study, May through August. Young-of-the-year were collected June through August (Table IV); however, larger numbers of young-of-the-year were collected in August than during any other month.

Total numbers of fish collected in August were higher than in May, June, or July, agreeing with findings by Smith (1963). This is biased, however, because most stations sampled in August were on the second-order stream. Second-order streams normally have larger fish populations than first-order streams (Harrel *et al.*, 1967).

TABLE IV. Initial collections of young-of-the-year fish in Thirty-two Mile Creek, 1977.

Species	First Collection Date	Station	Total Length (mm)
Cyprinus carpio	June 11	2	33
Pimephales promelas	June 25	4	27
Notropis lutrensis	July 5	6	30
Ictalurus melas	July 8	9	32
Ictalurus punctatus	July 12	6	36
Notropis stramineus	August 1	16	36
Phenacobius mirabilis	August 1	14	30

Previous research on Thirty-two Mile Creek is limited to a seine survey by Bliss and Schainost (1973) from 5 stations on the creek. Four of these stations were at the same sites as stations 3, 10, 12, and 15 of this study. The fifth station was located 0.8 km south of station 6. Bliss and Schainost (1973) collected only one species, *Noturus flavus,* stonecat, in Thirty-two Mile Creek which was not collected during the summer of 1977. Specimens of *Notropis stramineus, Phenacobius mirabilis, Semotilus atromaculatus,* and *Ictalurus punctatus* were collected for the first time in Thirty-two Mile Creek during 1977.

The dam on the lower, east branch of Thirty-two Mile Creek may have an effect on the distribution of fish species in this first-order stream. This dam is a permanent barrier to upstream movement, preventing immigration by new species. Also, the inlet to the lake consists of two large culverts which are 1.5 m above the surface of the lake. Fish which came through the culverts during high water would be prevented from returning upstream.

During dry periods the east branch above the dam dries except for the large pool above the culverts and a few other pools such as the one at station 2. Highly tolerant fish species which can withstand drought in residual pools are the only

species that would be expected in this branch. Fish collected here were all tolerant species (carp, black bullhead, green sunfish, and fathead minnow).

Predation by crayfish may have had an effect on fish abundance at station 3, which is located downstream from the Juniata sewage lagoons. Organic wastes present in the creek seemed to provide an ideal habitat for crayfish as about 40 were collected with each sweep of the seine. Repeated seining produced only 5 fish. Four of these fish were fathead minnows having gouges and slashes on their bodies, apparently from crayfish attacks. The other fish collected was a black bullhead, 170 mm in total length, the largest fish collected in Thirty-two Mile Creek, and apparently a successful predator of the crayfish. It seems that the large crayfish population at this station may have limited fish abundance, but it is possible that the primary limiting factor was pollution from the sewage lagoons.

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