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Fish Distribution in the Skunk River below Ames, Iowa¹

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Abstract. The Skunk River has been straightened most of the way from Ames to Colfax. In the summer of 1968, 24 species of fish were collected. There were few species other than minnows, and red shiner (*Notropis lutrensis*), bigmouth shiner (*N. dorsalis*) and sand shiner (*N. straminous*) were most abundant. Water levels were above normal during the study and effects of pollution upon fish distribution were not pronounced. The diversity index, d , at the station where treated-sewage wastes entered, was lower than at stations up and down stream but was higher than at the four stations farthest downstream. Uniformity of habitat resulting from stream-straightening probably limits species diversity.

Zach (1968) studied the species composition and population of the fishes in the Skunk River above Ames, Iowa. The present study is a continuation of that investigation downstream (Figure 1).

The study area extended from about 100 meters above old US Highway 30, Ames, Iowa, to US Interstate Highway 80, approximately 50 kilometers downstream. Ten stations were established in the study area. The habitat is quite uniform over the major portion of the study area. The river bed is sandy, with occasional holes scoured under fallen trees, stumps, or debris in the river. The channel has been altered by man, chiefly by straightening the river bed, and in some areas by the use of dikes and retaining walls. The result is a broad, shallow, slow-flowing, sand-bottomed stream.

Near Ames, sources of stream pollution possibly affect fish distribution. At Station 1 a sand and gravel washing operation has caused deposition of silt and sand in the channel. Just above Station 3, effluent from the Ames sewage-treatment plant enters the river. At low water stages, the effluent may be greater than the stream flow above where the effluent is added, but stream flow was never that low in 1968. A third possible source of pollution exists in the runoff of insecticides, herbicides, and organic material from the

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adjacent agricultural areas.

A proposed flood-control dam on the Upper Skunk River, north of Ames, Iowa, would regulate the volume flow of the river and provide a relatively stable dilution of effluents entering the river from the Ames sewage treatment plant. The present distribution of fishes in the Skunk River may be altered thereby.

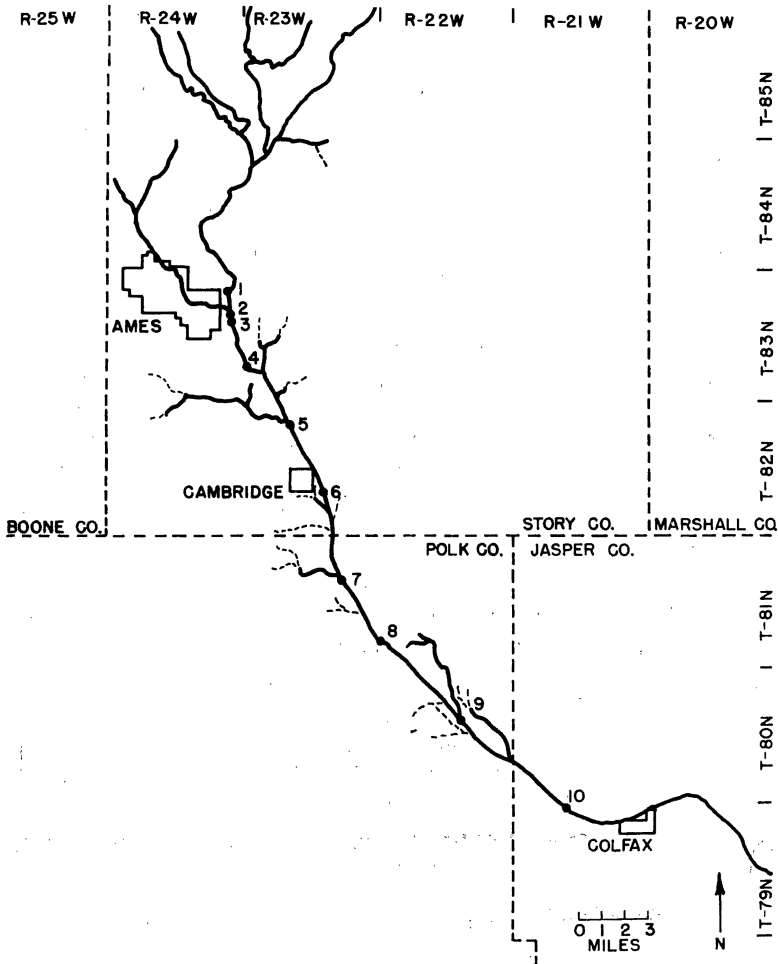


Figure 1. Stations sampled on the Skunk River in the summer of 1968.

METHODS AND MATERIALS

Six samples were taken, approximately weekly, from June 19 to August 6, 1968, at 10 stations. A minnow seine, 5 by 1 meter with

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4-mm bar mesh, was used for seining. All seining was done on a selective basis, with each haul designed to secure a maximum number of fish. Three seine hauls were made at each station for the six collections. The hauls were made with the current because that was the more effective way to collect fish (Paloumpis, 1958). An electric shocker, of 110-volt, 60 cycle, alternating current, was used to obtain one additional collection. Throughout the study all game fish were returned to the stream. The remaining fish were preserved in the field with 10% formalin. Fish less than 30 mm in total length were classified as young, and often were not identified as to species.

Water samples were collected and analyzed for oxygen, nitrates, phosphates, and ammonia concentrations in parts per million. The modified Winkler method was used to determine oxygen concentration. A Hach Co. DR colorimeter, serial #824B, was used to measure the concentrations of nitrates, phosphates, and ammonia.

STREAM CONDITIONS

Stream conditions varied greatly during the collection period. In June 1968, the volume flow ranged from 13.8 cfs (cubic feet per second) to 6110 cfs, July had a low of 66.8 cfs and a high of 931 cfs. The mean flow for the month of July was 211 cfs compared to a 5-year average (1963-67) of 107 cfs. With a relatively constant influx of effluent, the dilution factor of the river fluctuated rapidly.

Phosphate levels were significantly raised by the sewage treatment effluent and even at station 10, almost 50 km downstream were higher than in the river above the outlet (Table 1). Ammonia levels were also somewhat higher just below the outlet but had re-

Table 1

Water Analysis at Selected Stations on the Skunk River (Readings at 8:30 AM, values in parts per million. Station 1 is 50 m north of old US 30 Highway bridge; 3 is 50 m south of Ames sewage-treatment outlet; 10 is 1 km north of US Interstate 80 Highway bridge)

Date	Station Number											
	1	3	10	1	3	10	1	3	10	1	3	10
	NH ₃			PO ₄			NO ₃			O ₂		
6/20	1.0	0.5	— ¹	0.9	1.6	—	3.5	3.8	—	—	8.7	—
7/16	0.2	0.5	—	0.9	3.5	1.5	3.3	4.2	1.3	7.4	7.2	7.2
7/30	0.5	0.6	0.3	0.9	2.9	1.7	3.8	3.8	3.2	8.1	10.8	9.1
8/5	0.1	0.8	0.2	0.6	2.9	1.7	1.8	1.5	0.3	7.3	8.0	7.0

¹ Due to flood conditions, samples could not be obtained at the station.

turned to normal levels before station 10. All determinations were below 1.5 ppm of dissolved ammonia, which Ellis (1937) listed as the maximal amount not suggestive of specific organic pollution.

ANNOTATED LIST OF FISHES

Twenty-three species of fish were collected with seines, and electric shocking added the bigmouth buffalo. The following is an annotated list of the species collected.

Camptostoma anomalum (Rafinesque). Stonerollers were taken at all stations except 9 and 10, with 88% taken from stations 1 and 2. Stonerollers showed a preference for moderately turbid, rather shallow water over a sand, gravel, or rock bottom.

Cyprinus carpio Linnaeus. Carp were taken at stations 4 to 10. Only 7 specimens were collected by seining, but 26 were collected during the one period of electroshocking. The largest specimen was 520 mm in total length and weighed 1816 g; the smallest was 275 mm in total length and weighed 227 g.

Hybognathus hankinsoni Hubbs. Nine specimens of the brassy minnow were taken from stations (2, 3, 6, 9, 10) with pools having a sand-and-fine-gravel bottom. Harlan and Speaker (1956) reported the brassy minnow as a fish of moderate-size streams or small rivers, preferring pool habitats adjacent to these.

Notemigonus chrysoleucas (Mitchill). One golden shiner was collected where effluent from the Ames sewage-treatment plant enters the Skunk River.

Notropis atherinoides Rafinesque. The emerald shiner was taken in pools at all stations. Harlan and Speaker (1956) indicated that the emerald shiner is confined to the lower reaches of the streams tributary to the Mississippi and Missouri Rivers. Zach (1968) collected this species at two stations on the Skunk River near Ames, in swift-flowing rock-bottomed areas.

Notropis cornutus (Mitchill). Common shiners were abundant throughout the area except at Station 10, where only one specimen was collected. The common shiners were in deep pools with sand bottoms. Forbes and Richardson (1920) indicated that in Illinois this species shows a preference for clear waters and clean bottoms.

Notropis dorsalis (Agassiz). Bigmouth shiners were collected with the minnow seine at all stations and appeared to occupy a diverse number of habitats. It was the second most abundant species collected. Paloumpis (1958) found this shiner the most abundant species in Squaw Creek, Story County, Iowa. The maximum total length of this species was 75 mm, with only 3% in the 71-75 mm range. Young were collected as early as June 19. Several specimens had deformed bodies. The deformity began at the posterior part of the dorsal fin and continued for a few millimeters

toward the tail, giving a crooked appearance. Deformed shiners, observed in the laboratory aquarium, had a jerky movement while swimming.

Notropis lutrensis (Baird and Girard). The red shiner was the most abundant species collected and was taken at all stations. Paloumpis (1958) found this species the second most abundant in Squaw Creek, Iowa. Zach (1968) collected specimens in large numbers in the Skunk River above Ames. The red shiner shows great diversity in its distribution below Ames, preferring the more quiet parts of the river with sandy bottoms. A separate report on the life history of this species is being prepared.

Notropis spilopterus (Cope). Two specimens of the spotfin shiner were collected at Station 7. Harlan and Speaker (1956) state that this shiner prefers the shallow, swift water over sand flats or bars. This species was not collected above Ames by Zach (1968).

Notropis stramineus (Cope). The sand shiner was collected at all stations, primarily in pools with a sand bottom. It was the third most abundant species collected in the study. Paloumpis (1958) reported the species was rare in Squaw Creek, and collected it from areas with sand-silt bottoms. Zach (1968) found it common in the Skunk River above Ames.

Phenacobius mirabilis (Girard). The suckermouth minnow was collected at nine stations, mostly, from shallow swift current over a gravel and sand bottom. The largest specimen collected measured 63 mm in total length.

Pimephales notatus (Rafinesque). The bluntnose minnow was taken at all stations. It showed a preference for quiet areas with sand bottoms. Paloumpis (1958) found the species common in areas with a sand bottom and clear water.

Pimephales promelas Rafinesque. Nine fathead minnows were collected at stations 2, 3, 6 and 10. Zach (1968) reported the fathead minnow widely distributed in the streams above Ames, except in Kegley's Creek. Harlan and Speaker (1956) found that the fathead minnow prefers shallow, rather calm water and is rarely in the flowing water of the larger rivers. Paloumpis (1958) and Forbes and Richardson (1920) collected the species where water was muddy and the current was slow.

Semotilus atromaculatus (Mitchill). The creek chub was collected at nine stations in habitats with sand bottoms and moderate current.

Carpiodes carpio (Rafinesque). The river carpsuckers were collected at all stations, in habitats with bottoms of sand and silt. The largest specimen taken measured 305 mm total length and weighed 330 g. The carpsucker has a definite preference for large or mod-

erate sized streams (Harlan and Speaker, 1956). The three largest specimens were obtained by electroshocking. The seine was inefficient in collecting adults, which were often observed swimming around the seine or moving ahead of it. Zach (1968) also observed adult river carpsuckers moving around the seine. Young carpsuckers, too small to verify species identification, were collected only at the first seven stations.

Catostomus commersoni (Lacepede). The white sucker was collected at all stations except 3, 8, and 10. It was in the slower moving parts of the Skunk River, generally in pools with a sandy bottom. The largest specimen was 292 mm total length.

Ictiobus cyprinellus (Valenciennes). One bigmouth buffalo, measuring 395 mm total length, was collected with the electroshocker, at Station 5, in a pool with a sand bottom.

Ictalurus melas (Rafinesque). Two black bullheads were seined in an area of reduced current over a sand bottom at Station 9.

Ictalurus natalis (LeSueur). Three yellow bullheads were collected at stations 2, 4, and 6. The largest specimen was taken with the electroshocker and was 228 mm total length and weighed 256 g.

Ictalurus punctatus (Rafinesque). The channel catfish were collected in small deep pools with sand-silt bottoms at stations 2 and 8.

Lepomis cyanellus Rafinesque. Three green sunfish were captured at stations 6 and 8, in pools with sand bottoms where some cover was present in the form of partly submerged small trees or branches.

Micropterus dolomieu Lacepede. Smallmouth bass were not commonly taken with the minnow seine; they seemed to swim around or jump over it. Six specimens were collected at stations 1, 4, and 6. The bass prefer pools below riffles and the deeper parts of the stream where some cover is present. Young were first taken on July 30. Zach (1968) reported the first young on August 8 in 1967.

Pomoxis annularis Rafinesque. Thirteen white crappies were collected at stations 1 and 2, in deep holes with sand bottoms. Harlan and Speaker (1956) indicate that one specimen was taken near Ames between 1888 and 1948. Zach (1968) collected one specimen, with hook and line, in a deep pool in the Skunk River.

Etheostoma nigrum Rafinesque. Johnny darters were collected at all stations except 5, an area of fast current and sand bottom. The species shows a preference for riffles and stream areas over gravel or rocks. It appears quite adaptable to a wide range of habitat. The largest specimen was 48 mm in total length.

DISCUSSION

This study added no species not previously reported for the Skunk River. Eight species were not found which were reported for the river system above Ames by Zach (1968). These were northern redhorse, northern hog sucker, stonecat, largemouth bass, bluegill, orangespotted sunfish, black-sided darter, and fantail darter. Most of these are typically headwater fish, with little suitable habitat in the section of river from Ames to Colfax.

Harlan and Speaker (1956) reported that highfin carpsucker, golden redhorse, slender madtom, hornyhead chub, silver chub, and blacknose dace were collected from the Skunk River by the Iowa Conservation Commission since 1945. The highfin sucker and golden redhorse are species which may easily avoid a small seine, and were probably never abundant in the river. The slender madtom, hornyhead chub, and blacknose dace are headwater species. Silver chub are confined to the semi-turbid waters and channels of the large inland streams and are comparatively rare (Harlan and Speaker, 1956).

From 11 to 18 species were collected at each station (Table 2) and there were no striking differences in species distribution or numbers, which could be associated with the suspected pollution sources nor other habitat features. Wilhm and Dorris (1968) recommend the use of diversity indexes as measures of water quality and pollution. The diversity index which they use is

$$\bar{d} = -\sum (n_i/n) \log_2 (n_i/n)$$

where n_1 = number of individuals in each species
and n = total number of individuals in collection

The more diverse the community, the higher the value of \bar{d} and when there is only one species $\bar{d} = 0$. Using macroinvertebrates in benthic communities, Wilhm and Dorris (1968) found \bar{d} values less than 1 in areas of heavy pollution, values of 1 to 3 in areas of moderate pollution, and values exceeding 3 in clean water areas. The \bar{d} values for the combined fish collections at each station ranged from 1.51 to 3.00. Without \bar{d} values on other fish populations in Iowa streams it is difficult to interpret these values with respect to pollution. The diversity index is lower at Station 3, where the Ames sewage-treatment plant outflow enters the river, than above or below, except that the four stations furthest downstream have lower values. Collections at these stations had more individuals than at the upstream station but red and bigmouth shiners constituted 86% of the population. Species diversity is probably fairly low for the section of the Skunk River included in this study because of uniformity of the habitat resulting from

Table 2

Numbers of Fish of Each Species Collected from the Skunk River, June 19-August 6, 1968. The effort at each station was approximately equal

Species	Stations									
	1	2	3	4	5	6	7	8	9	10
Red shiner	342	220	191	170	158	267	413	341	1079	528
Bigmouth shiner	162	85	230	146	50	158	398	192	524	307
Sand shiner	55	59	118	81	51	175	149	39	147	79
Bluntnose minnow	83	11	3	17	2	60	2	4	26	18
Emerald shiner	42	34	38	18	26	11	24	19	2	5
Common shiner	53	22	27	10	32	10	9	18	7	1
Carp suckers	97	45	3	3	8	4	1	1	1	1
Stoneroller	29	34	0	1	1	4	0	2	0	0
White sucker	12	14	0	10	4	25	3	0	2	0
Suckermouth minnow	4	50	0	1	2	1	0	0	1	0
Creek chub	10	2	2	9	1	7	5	1	9	0
Carp	0	0	0	2	4	8	7	5	5	2
Johnny darter	3	8	3	2	0	3	4	5	2	1
Fathead minnow	0	1	3	0	0	13	0	0	0	1
White crappie	3	10	0	0	0	0	0	0	0	0
Brassy minnow	0	2	1	0	0	4	0	0	1	1
Smallmouth bass	1	0	0	0	0	3	0	0	0	0
Black bullhead	0	0	0	0	0	0	0	0	2	0
Yellow bullhead	0	1	0	1	0	1	0	0	0	0
Green sunfish	0	0	0	0	0	2	0	0	0	0
Channel catfish	0	1	0	0	0	0	0	0	1	0
Spotfin shiner	0	0	0	0	0	0	2	0	0	0
Golden shiner	0	0	1	0	0	0	0	0	0	0
Total	896	399	620	471	339	756	1017	627	1809	944
Number of species	14	17	12	14	12	18	12	11	15	11
Diversity (\bar{d})	2.75	3.00	2.16	2.36	2.35	2.61	1.84	1.76	1.51	1.52

straightening and other modifications made by man. The \bar{d} for all collections combined was 2.26. The maximum diversity index with 23 species, each equally represented in the sample, would be 12.02.

Since water levels remained fairly high throughout the study, effects of pollution on distribution of the fish may have been much less than in years of normal flow.

Diversity indexes can also be computed for the individual col-

lections at each station. The lowest \bar{d} at Station 3 was 1.56 on August 5 when the water level was lowest. At some other stations low \bar{d} values were 1.69 at Station 5 on August 5, 1.43 at Station 4 on July 23, 1.02 at Station 9 on July 3, 0.94 at Station 7 on July 2, and 0.92 at Station 10 on July 31. The July 2 and 3 collections were rather small because of high water.

Although most of the fish were measured and plotted in length frequency diagrams, growth rates of the various species were not readily followed, perhaps because of failure to identify many of the fish under 30 mm and because of the number of stations sampled. Standard, fork, and total lengths of many specimens were recorded so that the ratios between these lengths could be determined (Table 3).

Table 3

Ratios of Standard and Fork Lengths to Total Lengths for Several Species of Fish, Skunk River, 1968

	Range of TL	Number Measured	FL/TL	SL/TL
Stoneroller	71-101	2	0.936	0.802
Emerald shiner	46-88	99	0.907	0.805
Common shiner	35-136	73	0.925	0.815
Bigmouth shiner	49-75	231	0.921	0.797
Red shiner	38-72	224	0.892	0.784
Sand shiner	40-71	115	0.913	0.808
Spotfin shiner	60-69	2	0.907	0.806
Suckermouth minnow	68	1	0.926	0.823
Bluntnose minnow	36-66	18	0.930	0.818
Fathead minnow	45-62	4	0.945	0.825
Creek chub	92-150	2	0.954	0.826
Carp suckers	30-123	22	0.915	0.776
Johnny darter	27-30	2	—	0.807

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