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FISH COLLECTIONS IN THE BRULE-IRON RIVER SYSTEM, IRON COUNTY, 1961-1962

By Wilbert C. Wagner

The Brule-Iron river system was surveyed for fish distribution and abundance on October 1-5, 1961. This survey was made as a part of a program to inventory the fish fauna of the major stream systems in Michigan. Emphasis was placed on the collection of game fish to facilitate future fish management programs. On December 3-5, 1962, a portion of the system was resurveyed to determine the effect of acid mine water, containing large amounts of iron in solution, on the fish population. The mine water began entering the system in January, 1962.

From its origin at Brule Lake to its confluence with the Michigamme River, the Brule River forms the boundary between Michigan and Wisconsin. The length of the main stream and its Michigan tributaries is approximately 150 miles; the drainage area is approximately 190 square miles. The Brule River is a part of the Menominee River drainage system.

The topography in the western portion of the watershed, around Brule Lake, is generally rolling. The soils are clay and gravelly loams and are covered with hardwoods. To the east, the terrain becomes rather

flat and consists of clay loams with some sandy area. The timber is mostly aspen and pine. The lower part of the watershed, from US-2 downstream, is generally rolling. The sand and gravelly loams are covered with a mixture of spruce, aspen, and other hardwoods. Rock outcroppings are common in the area around Brule Dam.[1]

Fishing quality

The fishing quality in the Brule River has been summarized by District Fisheries Supervisor Florin Warren as follows:

"The Brule River is considered a fair trout stream. Brook and brown trout are caught in Brule Lake, which is the headwaters of the stream. Fair to good brook and brown trout fishing is reported from the lake downstream to the junction with the Iron River. Rainbows are also taken in that part of the river, but hatchery stocking is probably the backbone of the rainbow fishery. No runs of spawning rainbow trout have been observed or reported.

"From the junction with the Iron River downstream, trout fishing is mostly mediocre, probably due in part to dirty water pumped into the Iron River from the mines. This mine water, along with sewage, causes an algal growth in the warm weather that is very difficult to fish in. Fishermen report catching few trout, but the ones caught are large.

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[1] Personal communication from District Fisheries Supervisor Florin Warren.

"From US-2 downstream, the Brule River contains mostly warm-water fish. Game fish present are walleyes, northern pike, crappies, perch, bluegills, rock bass, and pumpkinseeds. Rough fish present are mostly suckers and creek chubs. Walleye fishing is good during the spawning run in the spring, and fishing is fair for all species in the reservoir formed by the Brule Plant dam, owned by the Wisconsin-Michigan Power Company.

"The Brule River, being a Wisconsin-Michigan boundary water, is covered by boundary regulations which permit year round fishing for walleyes and northern pike. The Iron River, which is the largest tributary of the Brule River, is an excellent brook trout stream above where the mine water enters. Some of the smaller tributaries are also good brook trout streams."

Methods

In 1961, the field party included District Fisheries Supervisors L. R. Anderson, T. B. Durling, C. F. Long, and F. J. Warren; and Institute for Fisheries Research biologists G. P. Cooper, M. G. Galbraith, F. F. Hooper, J. T. McFadden, and T. M. Stauffer. In 1962, collections were made by T. M. Stauffer and M. J. Hansen from the Institute for Fisheries Research assisted by Messrs. J. Bal, R. Carr, and C. Fetterolf from the Water Resources Commission.

In 1961, 31 fish collections were made on the Brule River and its Michigan tributaries. Within the limits of accessibility, stations were

selected to sample the fish population in representative types of habitat throughout the system. The location of the collecting stations are shown in Figure 1. All stations sampled in 1962, except for Station 32, were duplicates of those sampled in 1961. Four stations were sampled on the Brule River and three stations on the Iron River in the area affected by the acid mine water pollution (Fig. 1). One station on the Brule River and one station on the Iron River were sampled upstream from the polluted area.

At each collecting station, a three-man crew operated a 220-volt, direct-current shocker for 15 to 75 minutes. Generally, collecting was most efficient in small, shallow streams with slow, clear water and ample cover. In the deep, wide, muddy water found in the lower part of the Brule River, collecting efficiency was generally very poor. During this survey as in past surveys, it was noted that in large deep streams fish often escape from the electrical field of the shocker. Satisfactory collections usually cannot be made in water more than 3 feet deep. Physical characteristics of the stations are presented in Table 1.

With the exception of a few large game fish, which were scale sampled, measured, and released, all fish collected were preserved in 10-percent formalin for later identification. In 1961, all preserved fish were identified by the author and verified by T. M. Stauffer, M. J. Hansen, or W. R. Crowe. In 1962, all fish were identified by M. J. Hansen and verified by T. M. Stauffer. All game fish collected in 1961 were

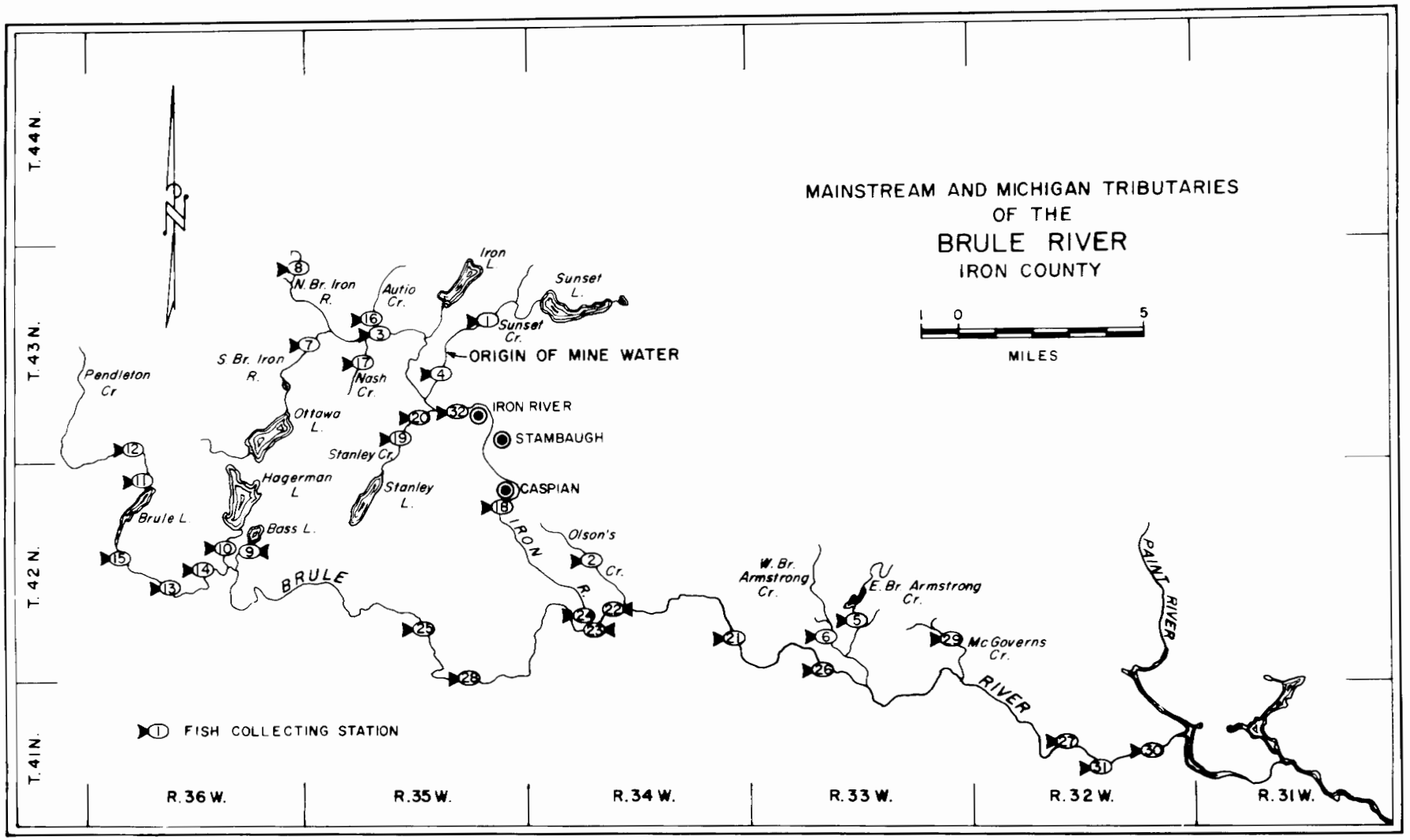

Figure 1.--Map of Brule River and tributaries, showing fish-collection stations.

Table 1.--Physical characteristics of stations in the Brule River system

Stream[1]	Station[1] Number	Location T (N)	Location R (W)	Location Section	Water level	Volume[2]	Water color[3]	Turbidity	Bottom type[4]	Cover	Velocity[5]	Conductivity[6]	CE[7]
Brule River	30	41	32	11	high	175	DB	murky	RBG	fair	R	242	fair
	30a[8]				norm.	150	MB	muddy	RGS	good	R		poor
	31	41	32	15	high	200	LB	murky	GRB	good	R	242	fair
	31a[8]				norm.	185	MB	muddy	GRB	good	R		poor
	27	41	32	9	norm.	200	LB	murky	GRBSt	poor	R	242	poor
	26	42	33	33	high	150	LB	muddy	GRBSt	poor	R	250	poor
	21	42	34	25	norm.	320	LB	muddy	GRS	-	R	242	poor
	21a[8]				low	150	-	muddy	GR	good	R		poor
	22	42	34	21	high	319	LB	muddy	RGSt	-	R	174S[9] 320N	fair
	22a[8]				norm.	150	-	muddy	RGS	good	R		poor
	23	42	34	29	high	100	DB	clear	BRG	poor	R	148	fair
	23a[8]				norm.	100	LB	clear	GR	poor	R		fair
	28	42	35	35	norm.	42	C	clear	GRSSt	-	R	118	poor
	25	42	35	27	norm.	150	LB	clear	GRStS	fair	R	108	fair
	14	42	36	15	high	75	LB	clear	SStG	poor	SR	98	fair
	13	42	36	21	high	75	LB	clear	SStG	good	SR	99	fair
	15	42	36	18	norm.	30	C	clear	GSStR	fair	S	114	poor
McGoverns Creek	20	42	33	25	high	1	C	clear	O	-	S	250	poor
East Branch Armstrong Cr.	5	42	33	28	norm.	5	LB	clear	SStR	good	S	163	good
West Branch Armstrong Cr.	6	42	33	28	high	12	LB	clear	R	poor	R	258	good
Olsons Cr.	2	42	34	17	high	4	-	-	-	-	R	286	-

Table 1.--continued

Stream[1]	Station[1] Number	Location T (N)	Location R (W)	Location Section	Water level	Volume[2]	Water color[3]	Turbidity	Bottom type[4]	Cover	Velocity[5]	Conductivity[6]	CE[7]
Iron River	24	42	34	29	high	40	DB	murky	GRB	good	R	500	good
	24a[8]				low	40	-	muddy	GRB	good	R		fair
	18	42	35	12	high	50	B	murky	RG	good	R	533	poor
	18a[8]				norm.	30	-	muddy	RG	good	R		fair
	32[8]	43	35	26	norm.	40	GB	murky	-	good	R	1,062	poor
	3	43	35	17	norm.	65	B	clear	SRStG	-	SR	160	fair
	3a[8]				low	20	LB	clear	GRB	good	SR		good
Stanley Creek	20	43	35	27	norm.	1	C	muddy	GR	poor	-	178	fair
	19	43	35	33	norm.	1	C	clear	GRSSt	good	SR	170	-
Sunset Cr.	4	43	35	22	high	10	B	muddy	-	fair	R	195	fair
	1	43	35	13	high	10	LB	clear	SStR	fair	SR	125	good
Autio Cr.	16	43	35	8	high	1	B	murky	St	-	S	111	fair
Nash Cr.	17	43	35	20	high	5	LB	clear	StSC	-	S	160	fair
South Branch Iron River	7	43	35	18	norm.	10	C	clear	SStG	poor	-	174	good
North Branch Iron River	8	43	36	1	norm.	6	C	clear	StO	fair	-	138	fair
Bass Cr.	9	42	36	14	high	1	C	clear	SGRSt	good	SR	42	good
Hagerman Cr.	10	42	36	15	norm.	1	C	clear	GSSt	-	SR	103	good
Pendleton Cr.	11	42	36	5	high	8	LB	clear	RBSt	fair	R	103	fair
	12	43	36	32	high	8	LB	clear	RBStS	fair	R	107	poor

(footnotes on next page)

Footnotes, Table 1

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[1] Stream and stations are listed in order, progressing upstream from the mouth.

[2] Estimated volume in cubic feet per second.

[3] B = brown; C = colorless; DB = dark brown; GB = greenish brown; LB = light brown; MB = muddy brown.

[4] Predominant bottom types (B = boulders; C = clay; G = gravel; O = organic; R = rubble; S = sand; St = silt). Where two or more types are shown together, the principal component precedes.

[5] Estimated velocity. S = sluggish (less than 1/2 foot per second); R = rapid (greater than 1/2 foot per second); SR = sluggish-rapid (velocity varied in station).

[6] Conductivity expressed as micro-ohms at 18° C. The conductivity of the water was relatively high in 1962, except at stations 3 and 23. The high conductivity was indicated by the heavy load on the shocking generator and the high conductivity reading at Station 32 (62).

[7] Collecting efficiency--the crew leaders' judgment of overall efficiency of the collecting as influenced by level, volume, color, turbidity, velocity, and conductivity of the water, and bottom type, cover, light conditions, and experience of crew members.

[8] Collection made in December, 1962.

[9] The water from the Brule and Iron rivers was not completely mixed at this point. The first reading was taken from the south side (mostly Brule River water) and the second reading from the north side (mostly Iron River water).

measured, and scale samples were taken from trout over 3.5 inches in total length. Maximum and minimum lengths were recorded for all species of fish in each collection from both surveys.

Fish distribution in 1961

Names of fishes in this report conform to the list of common and scientific names of fishes published by the American Fisheries Society (1960). The 33 species which were found in the Brule River system during the survey are listed in Table 2.

The number of each species collected at each station, number collected at all stations, and number of stations where each species was collected are shown in Table 3. Brook trout (268 collected at 21 stations) were collected throughout the system but brown trout (52 collected at 8 stations) were collected only from the main stream or from tributaries at stations near the main stream. Three rainbow trout were collected at Station 3 on the Iron River, but the scale samples indicated that these trout were hatchery reared. Planting records show that rainbow trout of the same year class as those collected were planted at this location. Six species of warm-water game fish (smallmouth bass, largemouth bass, bluegill, rock bass, walleye, and yellow perch) were collected at various locations in the stream system but only at stations below lakes. The most common forage and rough fish were blacknose dace (1,672 collected at 27 stations) and white suckers (364 collected at 24 stations).

Table 2.--Species of fish collected in the Brule River system

Common name	Scientific name
Rainbow trout	Salmo gairdneri
Brown trout	Salmo trutta
Brook trout	Salvelinus fontinalis
Central mudminnow	Umbra limi
Northern redbelly dace	Chrosomus eos
Finescale dace	Chrosomus neogaeus
Brassy minnow	Hybognathus hankinsoni
Hornyhead chub	Hybopsis biguttata
Lake chub	Hybopsis plumbea
Golden shiner	Notemigonus crysoleucas
Common shiner	Notropis cornutus
Blacknose shiner	Notropis heterolepis
Bluntnose minnow	Pimephales notatus
Fathead minnow	Pimephales promelas
Blacknose dace	Rhinichthys atratulus
Longnose dace	Rhinichthys cataractae
Creek chub	Semotilus atromaculatus
Pearl dace	Semotilus margarita
Longnose sucker	Catostomus catostomus
White sucker	Catostomus commersoni
Black bullhead	Ictalurus melas
Banded killifish	Fundulus diaphanus
Brook stickleback	Eucalia inconstans
Rock bass	Ambloplites rupestris
Bluegill	Lepomis macrochirus
Smallmouth bass	Micropterus dolomieui
Largemouth bass	Micropterus salmoides
Iowa darter	Etheostoma exile
Johnny darter	Etheostoma nigrum
Yellow perch	Perca flavescens
Logperch	Percina caprodes
Walleye	Stizostedion vitreum vitreum
Mottled sculpin	Cottus bairdi

Table 3.--Number of fish collected at stations in the Brule River system, October 1-5, 1961 and December 3-5, 1962

Species	Stream[1] and station numbers									
	Brule River									
	30	30a[2]	31	31a[2]	27	26	21	21a[2]	22	22a[2]
Rainbow trout	-	-	-	-	-	-	-	-	-	-
Brown trout	-	-	-	-	-	-	-	-	4	-
Brook trout	-	1	2	1	1	-	-	2	8	-
Mudminnow	-	-	-	-	-	-	-	-	-	-
Redbelly dace	-	-	-	-	-	-	-	-	-	-
Finescale dace	-	-	-	-	-	-	-	-	-	-
Brassy minnow	-	1	-	1	-	-	-	-	-	-
Hornyhead chub	3	1	-	-	-	-	-	-	-	-
Lake chub	4	-	6	-	2	28	19	1	24	2
Golden shiner	-	-	-	-	-	-	-	-	-	-
Common shiner	8	1	-	-	11	8	40	1	20	-
Blacknose shiner	-	-	-	-	-	-	-	-	-	-
Bluntnose minnow	-	-	-	-	-	-	-	-	-	-
Fathead minnow	-	-	-	-	-	-	-	-	-	-
Blacknose dace	68	4	53	1	116	140	101	-	50	2
Longnose dace	9	37	10	2	10	7	2	-	3	-
Creek chub	69	18	9	15	55	62	76	1	59	4
Pearl dace	-	8	1	2	-	-	2	-	-	1
Longnose sucker	-	7	1	-	-	1	1	3	-	2
White sucker	3	-	-	3	1	11	15	9	27	7
Black bullhead	-	-	-	-	-	-	-	-	-	-
Banded killifish	-	-	-	-	-	-	-	-	-	-
Brook stickleback	-	-	-	-	1	1	1	-	1	-
Rock bass	1	1	-	-	-	-	-	-	-	-
Bluegill	-	-	-	-	-	-	-	-	-	-
Smallmouth bass	4	-	1	-	-	-	-	-	-	-
Largemouth bass	1	-	-	-	1	-	-	-	-	-
Iowa darter	-	-	-	-	-	-	-	-	-	-
Johnny darter	-	-	-	-	-	-	-	-	-	-
Yellow perch	2	-	1	1	4	-	8	1	16	3
Logperch	-	-	-	-	2	1	2	-	1	1
Walleye	-	-	-	-	-	-	-	-	-	-
Mottled sculpin	27	26	5	1	30	14	8	4	4	2
Collecting time (minutes)	50	40	30	35	60	75	50	40	60	45

Table 3.--continued

Species	Stream[1] and station numbers									
	Brule River (continued)							McGovern Creek	E.Br. Armstrong Creek	W.Br. Armstrong Creek
	23	23a[2]	28	25	14	13	15	29	5	6
Rainbow trout	-	-	-	-	-	-	-	-	-	-
Brown trout	12	2	1	1	-	-	-	-	-	17
Brook trout	15	7	9	1	-	2	-	4	-	42
Mudminnow	-	-	-	-	5	-	-	-	7	-
Redbelly dace	-	-	3	-	14	-	24	1	-	-
Finescale dace	-	-	-	-	-	-	-	2	-	-
Brassy minnow	-	-	-	2	5	-	-	-	-	-
Hornyhead chub	-	-	-	1	6	4	-	-	-	-
Lake chub	2	-	-	-	-	-	-	-	-	-
Golden shiner	-	-	-	-	-	-	-	-	3	-
Common shiner	5	-	10	23	4	17	-	-	2	-
Blacknose shiner	-	-	-	6	2	3	-	-	55	-
Bluntnose minnow	-	-	-	-	-	-	-	-	4	6
Fathead minnow	-	-	-	-	-	-	-	-	-	-
Blacknose dace	146	98	76	129	16	58	48	-	38	71
Longnose dace	5	5	10	2	-	-	3	-	-	1
Creek chub	28	19	37	36	85	19	11	-	14	1
Pearl dace	-	-	1	17	147	44	-	-	-	-
Longnose sucker	-	-	1	-	-	6	-	-	-	-
White sucker	8	26	4	10	18	11	6	-	19	-
Black bullhead	-	-	-	-	-	1	-	-	-	-
Banded killifish	-	-	-	-	-	-	-	-	-	-
Brook stickleback	-	-	-	-	2	-	1	10	3	2
Rock bass	-	-	-	-	-	-	-	-	42	-
Bluegill	-	-	-	-	-	-	-	-	4	-
Smallmouth bass	-	-	-	-	-	2	-	-	-	-
Largemouth bass	-	-	-	-	-	-	1	-	1	-
Iowa darter	-	-	-	-	-	-	-	-	2	-
Johnny darter	-	-	-	-	1	-	-	-	-	-
Yellow perch	1	-	-	7	5	2	8	-	-	-
Logperch	-	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-	-
Mottled sculpin	21	46	32	10	33	26	123	2	-	38
Collecting time (minutes)	60	50	50	30	30	40	65	40	30	30

Table 3.--continued

Species	Stream[1] and station numbers							
	Olsons Creek	Iron River						
	2	24	24a[2]	18	18a[2]	32[2]	3	3a[2]
Rainbow trout	-	-	-	-	-	-	3	-
Brown trout	-	1	-	-	-	-	-	-
Brook trout	-	2	-	1	-	-	22	8
Mudminnow	-	1	-	3	-	-	2	-
Redbelly dace	-	-	-	-	-	-	-	-
Finescale dace	-	-	-	-	-	-	-	-
Brassy minnow	-	-	-	-	-	-	-	-
Hornyhead chub	-	-	-	-	-	-	-	-
Lake chub	-	10	-	11	-	-	-	-
Golden shiner	-	-	-	-	-	-	-	-
Common shiner	-	11	-	17	-	-	-	-
Blacknose shiner	-	-	-	-	-	-	-	-
Bluntnose minnow	-	-	-	-	-	-	-	-
Fathead minnow	-	-	-	-	-	-	-	-
Blacknose dace	3	2	-	9	-	-	72	77
Longnose dace	-	-	-	-	-	-	37	10
Creek chub	-	8	-	12	-	-	-	1
Pearl dace	-	-	-	-	-	-	1	-
Longnose sucker	-	5	-	1	-	-	-	-
White sucker	-	32	-	72	-	-	3	1
Black bullhead	-	-	-	-	-	-	-	-
Banded killifish	-	-	-	-	-	-	-	-
Brook stickleback	-	-	-	1	-	-	2	-
Rock bass	-	-	-	-	-	-	-	-
Bluegill	-	-	-	-	-	-	-	-
Smallmouth bass	-	-	-	-	-	-	-	-
Largemouth bass	-	-	-	-	-	-	-	-
Iowa darter	-	-	-	-	-	-	-	-
Johnny darter	-	-	-	-	-	-	-	-
Yellow perch	-	7	-	2	-	-	-	-
Logperch	-	-	-	-	-	-	-	-
Walleye	-	1	-	-	-	-	-	-
Mottled sculpin	-	-	-	-	-	-	32	55
Collecting time (minutes)	15	40	35	65	35	25	60	25

Table 3.--continued

Species	Stream[1]/ and station number								
	Stanley Creek		Sunset Creek		Autio Creek	Nash Creek	S.Br. Iron River	N.Br. Iron River	Bass Creek
	20	19	4	1	16	17	7	8	9
Rainbow trout	-	-	-	-	-	-	-	-	-
Brown trout	-	-	-	-	-	-	-	-	-
Brook trout	12	10	-	73	17	3	34	5	-
Mudminnow	2	-	3	3	4	8	1	4	-
Redbelly dace	11	1	5	4	-	-	20	153	-
Finescale dace	-	-	-	-	-	-	-	7	-
Brassy minnow	12	-	-	-	-	-	-	-	-
Hornyhead chub	-	-	-	-	-	-	-	-	-
Lake chub	-	-	-	-	-	-	-	-	-
Golden shiner	-	-	-	-	-	-	-	-	-
Common shiner	-	-	-	-	-	-	2	47	-
Blacknose shiner	-	-	-	-	-	-	-	6	-
Bluntnose minnow	-	-	-	-	-	-	-	-	-
Fathead minnow	-	-	1	-	-	-	-	32	-
Blacknose dace	3	-	24	53	-	1	40	133	-
Longnose dace	-	-	-	-	-	-	-	4	-
Creek chub	62	13	23	5	-	-	14	3	1
Pearl dace	21	-	111	14	-	3	3	4	-
Longnose sucker	-	-	-	-	-	-	-	-	-
White sucker	10	-	9	1	-	7	2	80	1
Black bullhead	-	-	-	-	-	-	-	-	-
Banded killifish	-	-	-	-	-	-	1	-	-
Brook stickleback	6	-	15	1	4	10	1	61	-
Rock bass	-	-	-	-	-	-	-	-	-
Bluegill	-	-	-	-	-	-	-	-	-
Smallmouth bass	-	-	-	-	-	-	-	-	-
Largemouth bass	-	-	-	-	-	-	-	-	-
Iowa darter	1	-	-	-	-	-	-	4	-
Johnny darter	-	-	-	-	-	-	-	-	-
Yellow perch	5	4	-	2	-	-	-	-	2
Logperch	-	-	-	-	-	-	-	-	-
Walleye	-	-	-	-	-	-	-	-	-
Mottled sculpin	2	2	1	37	-	21	14	109	-
Collecting time (minutes)	20	15	50	40	30	-	20	25	35

Table 3.--concluded

Species	Stream[1] and station numbers			Total number of fish collected[3]	Number of stations where species collected[3]
	Hagerman Creek	Pendleton Creek			
	10	11	12		
Rainbow trout	-	-	-	3	1
Brown trout	-	8	8	52	8
Brook trout	-	1	4	268	21
Mudminnow	16	-	-	59	13
Redbelly dace	-	1	-	237	11
Finescale dace	-	-	-	9	2
Brassy minnow	1	-	-	20	4
Hornyhead chub	-	2	-	16	5
Lake chub	-	-	-	106	9
Golden shiner	-	-	-	3	1
Common shiner	45	4	-	274	17
Blacknose shiner	-	-	-	72	5
Bluntnose minnow	-	-	-	10	2
Fathead minnow	-	-	-	33	2
Blacknose dace	57	90	75	1,672	27
Longnose dace	-	5	10	118	15
Creek chub	28	12	4	746	26
Pearl dace	5	6	-	380	15
Longnose sucker	-	-	-	16	7
White sucker	10	4	-	364	24
Black bullhead	-	-	-	1	1
Banded killifish	-	-	-	1	1
Brook stickleback	-	-	-	123	18
Rock bass	-	-	-	43	2
Bluegill	-	-	-	4	1
Smallmouth bass	-	-	-	7	3
Largemouth bass	2	-	-	6	5
Iowa darter	1	-	-	8	4
Johnny darter	-	-	-	1	1
Yellow perch	-	-	-	76	16
Logperch	-	-	-	6	4
Walleye	-	-	-	1	1
Mottled sculpin	-	5	12	608	24
Collecting time (minutes)	30	30	40	-	-

[1] In names of streams, E. Br. = East Branch, W. Br. = West Branch. For location of stations, see Table 1 and Figure 1.

[2] Collections made in December, 1962.

[3] 1962 collections not included.

Age and growth of trout

In 1961, scale samples were taken from all trout over 3.5 inches in total length. Scale samples were not taken from trout collected in 1962. It was assumed that trout under 3.5 inches long, collected in the late summer or fall, were in age-group 0. This assumption held true for trout in the Brule River; in age-group I no brook trout under 4.1 inches or brown trout under 6.6 inches were collected.

A comparison of the average lengths of trout collected from the Brule River and average lengths of trout of the same age taken from various locations throughout the state during the month of October indicated that the growth rate of trout in the Brule River was somewhat slower than the state average. Because the number of trout in certain age groups was small, a valid comparison could be made only between brook trout in age-groups 0 and I, and brown trout in age-group 0. Comparisons are presented in Table 4.

Pollution

During the 1961 survey, pollution from flood water pumped from iron mines was noted in the Iron River downstream from its junction with Sunset Creek, and in the Brule River downstream from its junction with the Iron River. The iron mine flood water entered Sunset Creek 1 1/2 miles upstream from its junction with the Iron River (Fig. 1) and at several locations along the Iron River near the cities of Iron River, Stambaugh, and Caspian.

Table 4.--Number, average total length (inches), and range of lengths of brook and brown trout of various age groups collected from the Brule River system

Species and age group	Brule River system (1961)			State average[1]	
	Number collected	Average length	Range of length	Number collected	Average length
Brook trout					
0	155	3.3	2.3- 4.7	213	3.8
I	104	6.0	4.1- 8.7	262	6.2
II	7	8.3	7.0-10.1	22	9.6
III	1	12.2	12.2	1	11.5
Brown trout					
0	39	3.5	2.8- 4.6	288	4.3
I	5	7.3	6.6- 8.0	54	8.5
II	4	12.9	11.1-14.3	21	12.4
III	2	15.4	15.2-15.5	11	15.3
IV	1	16.1	16.1	3	19.3

[1] Personal communication from Edward Schultz, Fisheries Biologist, Institute for Fisheries Research.

In 1961, the catch per hour of fish at stations in the Brule and Iron rivers downstream from the outfall of the pollution was somewhat less than at stations upstream from the outfall. However, the collecting efficiency downstream from the outfall was lower because of the larger volume and the greater turbidity caused by the mining waste. Thus, the lower efficiency downstream from the outfall could have been the cause of the lower catch per hour.

In January, 1962, the Hanna Mine Company began pumping highly acid water, containing large amounts of iron in solution, from the Homer-Wauseca mine into Sunset Creek. Fish collections were made on December 3-5, 1962 to determine the effect of the acid mine water on the fish population. The results of this survey were reported by T. M. Stauffer in a letter dated December 10, 1962. A portion of his letter follows:

"During December 3-5, 1962, Mr. Hansen and myself, assisted by Messrs. Bal, Fetterolf and Carr of the Water Resources Commission, made nine fish collections in the Brule and Iron rivers . . . [see Fig. 1]. All stations, except Number 32, were duplicates of stations sampled in October, 1961. Four stations were in the mine-water area in the Brule River (from the Iron River to the Paint River), three were in the mine-water portion of the Iron River (from Sunset Creek to the Brule River), and two stations were sampled upstream, where mine water was not present. Characteristics of the sampling stations are shown in Table 1 [see Table 1]. In the Brule River mine-water area, collecting efficiency

in 1962 was reduced from that of 1961 by the increased turbidity. However, this may have been compensated for by the higher conductivity and smaller volume in 1962, which increased the collecting efficiency. In the Brule River, upstream from the Iron River, collecting conditions were better in 1962 because of the smaller volume. In the Iron River, collecting conditions were quite similar in both years except that the flow was slightly less in 1962.

"In the Brule River between the Iron and Paint rivers, 18 species were taken in 1961 and 14 in 1962 . . . [see Table 3]. Species present in 1961, but not found in 1962, included brown trout, smallmouth bass, largemouth bass, logperch and brook stickleback (brassy minnows were collected in 1962 but not in 1961). Since the 1961 populations of these fish were apparently small, they conceivably could have been missed by chance in 1962. Although the number of species collected in 1962 decreased progressing upstream to the mouth of the Iron River, the slight decrease was not deemed significant. I conclude that the species composition in the mine-water area of the Brule has not changed appreciably.

"The catch per hour of all fish in the Brule River above the Iron River was similar in both years, but the average catch per hour of all fish in 1961 in the Brule River between the Iron and Paint rivers was high (247) as compared to the 1962 catch per hour (67). The difference could be due to the presence of fewer fish or poorer collecting conditions in 1962. Although the very turbid water in 1962 reduced visibility, the

smaller volume and higher conductivity no doubt increased collecting efficiency and may have compensated for the high turbidity in 1962. Thus, there is a distinct possibility that the number of fish present in the mine-water area was less in 1962 than in 1961.

"In the Iron River below Sunset Creek, 12 species were collected in 1961 at a rate of 120 fish per hour, but no fish were found in 1962 . . . [see Table 3]. Our collection data strongly indicate that there are few, if any, fish remaining in the Iron River below Sunset Creek. On the other hand, fish were abundant in 1962 at a station in the Iron River upstream from Sunset Creek.

"Mr. Fetterolf obtained bottom samples at our fish collection stations and installed test fish in the Iron River. He found very little bottom fauna in the mine-water area of the Iron River. Of the test fish installed in the Iron River (Station 18), brook trout and blacknose dace succumbed within 24 hours."

About 1/4 mile above Station 20, on Stanley Creek, raw sewage from a slaughter house enters the stream. However, the Water Resources Commission has found that this is not causing a biochemical oxygen demand problem.[2] The fish collections made above and below the sewage outfall showed no detriment due to the pollution. In fact, the number of species and number of fish collected was greater in the polluted area than in the unpolluted area.

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[2] Personal communication from Joe Bal, Water Resources Commission.

Literature cited

American Fisheries Society. 1960. A list of common and scientific names of fishes from the United States and Canada. Am. Fish. Soc. Spec. Pub. No. 2, 102 pp.

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