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MONTANA DEPARTMENT OF FISH AND GAME
ECOLOGICAL SERVICES DIVISION

JOB PROGRESS REPORT

State Montana Title Lower Missouri River Basin

Project Number FW-2-R-8 Investigations

Job Number 1-b Title Planning Inventory, Fisheries

Period Covered July 1, 1978 through June 30, 1979

ABSTRACT

Fisheries and fisheries-related aquatic studies were continued on the Poplar River in 1978 to obtain information for determining impacts of a coal-fired electrical generation complex being constructed in Saskatchewan on the East Fork Poplar River. Electrofishing and seining were done to survey fish populations in the Redwater River and Big Muddy Creek. Most of the Big Muddy Creek drainage is devoid of game fish; small populations of some game species exist only in the extreme downstream portion. Game fish populations in the Redwater River are somewhat more extensive, with northern pike present upstream as far as the town of Circle.

Project field activities were moved to the Missouri River in spring 1979. Fish populations were surveyed using electrofishing gear. Larval fish were sampled with tow nets.

Popular River thermograph measurements were continued through 1978. Summer maxima consistently reached the 80 to 85 F range. Early morning dissolved oxygen measurements in summer 1978 indicated that values are relatively high with the exception of portions of the East Fork. Winter measurements early in 1979 in the East Fork indicated a possible winter-kill situation as occurred in 1978.

Poplar River bottom fauna standing crops are shown for November 1979. Sampling of walleye and northern pike spawners gave similar results in 1977 and 1978 except that fewer spawners were captured in 1978 than in 1977. Walleye eggs were sampled to determine physical characteristics of spawning sites. Larval walleye and northern pike were much more numerous in 1978 than in 1977, probably in response to much greater April-May streamflows in 1978.

Walleye and northern pike population estimates were made in nine stream sections in the Poplar River drainage in 1978. Age 0+ northern pike were much more numerous in 1978 than in 1979. Walleye age 0+ were much more numerous in the East Fork Poplar River in 1978. April-May streamflows are thought to be causative. Age 1+ and older walleye and northern pike were somewhat less abundant in 1978.

Spawning migrations of walleye and northern pike are mostly lacking in the Poplar River drainage. There is some evidence that sauger and walleye in the lower Poplar River are migratory.

Tentative instream flows have been formulated for the Poplar River drainage.

BACKGROUND

A description of the Poplar River, the problems related to development in the drainage, and aquatic work undertaken have been described in a previous report (Stewart 1978).

Spring streamflows in the Poplar River in 1977 were among the lowest ever recorded. Streamflows in 1978 were somewhat above average, with the exception of the East Fork Poplar River, where Cookson Reservoir impounded most of the streamflow. This gave an opportunity to assess fish populations and especially game fish reproduction under a wide range of streamflows.

By early 1979 Cookson Reservoir had filled and water was released to the East Fork Poplar River through spring 1979. Fall population estimates will again be made in 1979 to measure the effect on East Fork walleye and northern pike populations.

Considerable time was spent in 1978 in preparing tentative instream flows for the East Fork Poplar River. These flows were largely adopted by the Biological Resources Committee in their report to the International Poplar River Water Quality Board. Both groups have worked at the request of the Canada-United States International Joint Commission. Exactly what flows will be released on a continuing basis from Cookson Reservoir, in Canada, to the East Fork Poplar River are still unknown.

OBJECTIVES

Goals of this study are the completion of an inventory of fish populations and associated biological communities in the Poplar River drainage. Goals also included defining effects of the Canadian power plant development and determining ways of mitigating any detrimental effects on game fish populations. Specific 1978 objectives were the following:

A. Complete stream channel measurements, including width and depth, for stream sections where game fish population estimates are made;

B. Measure winter and summer dissolved oxygen at key locations;

C. Complete separation of quantitiative invertebrate samples from debris and enumerate organisms to appropriate taxonomic group; obtain identification of organisms in samples;

D. Tag game fish captured and determine spawning migrations by angler tag return and electrofishing recapture;

E. Locate spawning areas of game fish by electrofishing for spawners and by capturing larval fish with drift nets set in riffles and towed larval nets;

F. Estimate game fish numbers, age structure and growth in stream sections; locate rearing areas;

G. Monitor stream temperatures in the West and Middle Forks with thermographs; (East Fork temperature measurements by USGS);

H. Locate walleye eggs using an egg basket and make depth-velocity-substrate measurements; locate northern pike spawning sites by hand picking vegetation;

I. Determine upstream distribution of game fish in the West Fork Poplar River and its tributary, Cottonwood Creek;

J. Collect game fish for metals analysis from the East, West and Middle Forks of the Poplar River.

K. Develop tentative minimum instream flows for the Poplar River drainage using data developed during the project.

Other objectives include the survey of fish populations in the Redwater River and Big Muddy Creek, and making a start toward survey and inventory of fish populations in the Missouri River from Fort Peck dam to the North Dakota border.

PROCEDURES

Procedures used are detailed in a previous report (Stewart 1978), with the exception of larval fish sampling by towing. This procedure was not used for larval sampling in the earlier report. A nylon net of 760 micron mesh, 0.5 meter mouth diameter and 2 meter length was towed to the side of a boat at a speed of approximately 5 miles per hour. Towing was done in pools with the net positioned at the water surface. Sample handling was as previously described (Stewart 1978).

FINDINGS - POPLAR RIVER

Stream Channel Measurements

One additional section was measured in 1978. This was the Crowley section between the mouth and the West Fork Poplar River. See map (Figure 1) for station locations. Parameters measured were similar in value to the other sections measured in the Poplar River drainage in 1977 (Stewart 1978), except that the Crowley section is wider. Measurements on the Crowley section were made on July 31 and August 1 and 2, 1978 at a flow not yet published by the USGS, but probably between 10 and 15 cfs.

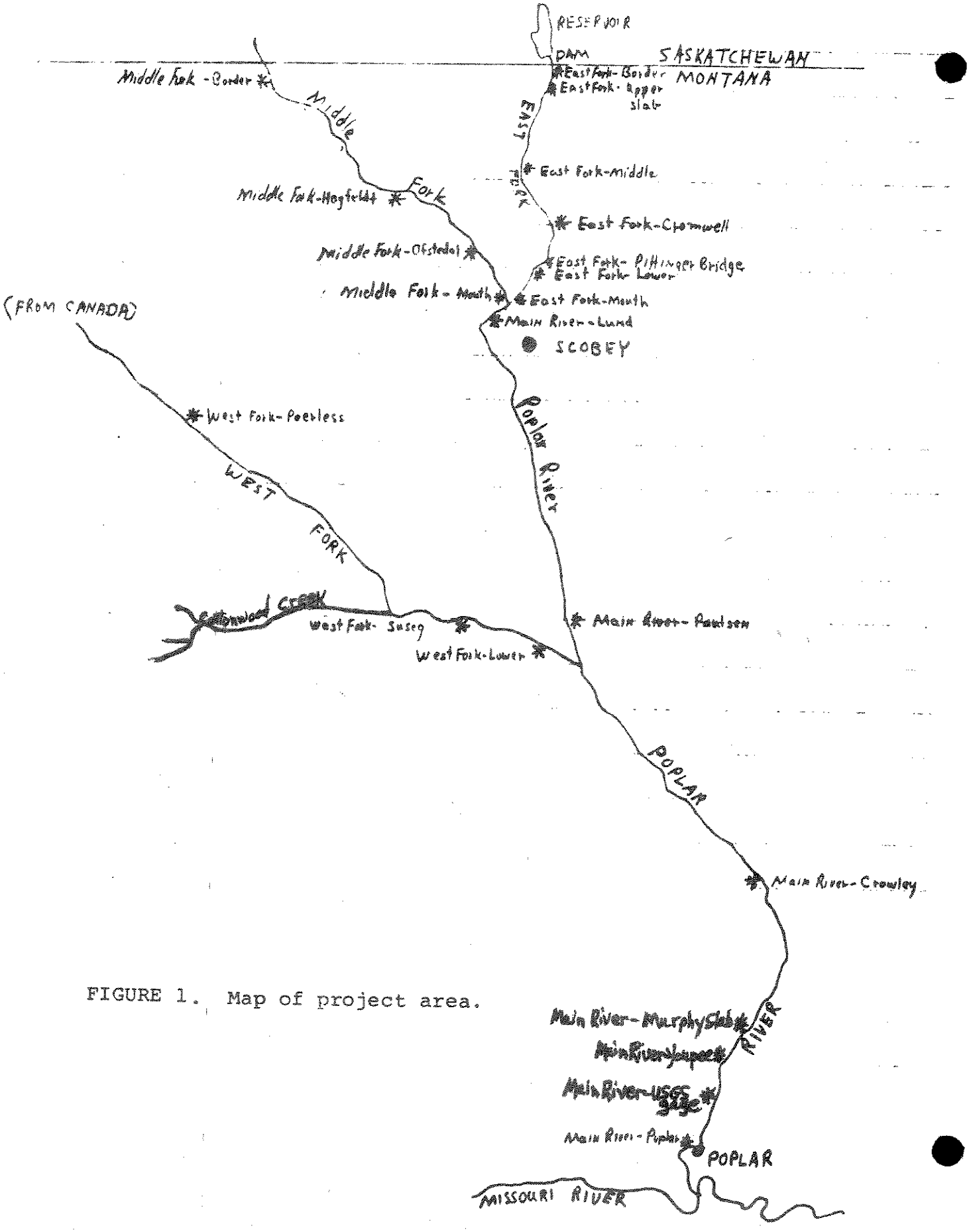

FIGURE 1. Map of project area.

The following are the results: section length - 11,300 feet; mean width - 81.3 feet; mean depth 1.69 feet; % of surface area deeper than 3, 4 and 5 feet is 18.6%, 9.0% and 3.1%, respectively.

Stream Temperature

Stream temperature measurements on the Poplar River are a cooperative effort with the U. S. Geological Survey. The USGS maintains thermographs on the East Fork Poplar River near the border and at the Pittinger bridge. (See Figure 1 for station locations.) Thermographs are maintained through the ice-free period on the Middle Fork (Ofstedal location) and on the West fork (Susag location) by the Montana Department of Fish and Game. A summary of monthly maximum and minimum temperatures is shown in Table 1.

Summer maximums reach 80 F most years. The maximum in 1975 was 85 F on the East Fork. Maximums on the West and Middle Forks are 83 F. These short-term extremes are probably not harmful to walleye and northern pike acclimated to temperatures not far below the extreme values. The lethal threshold temperature for northern pike acclimated to 77 F is 90 F (Committee on Water Quality Criteria 1972). Similar data for walleye were not found, but the lethal threshold temperature for this species is probably slightly lower. Small increases in stream temperature could cause fish kills. An increase in the duration of temperatures in excess of 80 F is undesirable because of possible fish stress and growth rate depression.

Dissolved Oxygen

Historical and winter 1977-78 dissolved oxygen values for the Poplar River drainage were shown in previous reports (Stewart 1978). Additional measurements were made in July and August 1978 between 4 and 8 a.m. to determine minimum summer dissolved oxygen values. Results are shown in Table 2.

With some exceptions, summer values were not far below saturation values of 8-9 milligrams per liter (Table 2). On the West and Middle Forks and on the main river, values were never significantly less than 6 mg/l. Values on the East Fork were mostly lower, averaging lowest at the middle station. Values were also low at times at the base of the dam. In the United States portion of the East Fork, only values at the middle station were sufficiently low to cause stress in walleye and northern pike. With this exception, summer dissolved oxygen in the Poplar River drainage does not appear to be a problem for fish.

Table 1. Monthly extreme water temperatures recorded for four Poplar River stations for 1975 to 1978 (^{o}F).

Station	Year	In-Out Dates	A	M	J	J	A	S	O	N
E. Fork	1975	-			78-56	85-67	73-54	64-45		
Border[a]	1976	-		70-43	79-59	78-60	77-55	68-49	59-35	42-33
	1977			74-49	79-53	83-61	74-55	71-44		
E. Fork	1976	-	55-35	70-54	79-59	79-64	77-55	70-48		
Pittinger Bridge[a]	1977		66-33	73-46	79-53	80-59	73-55	69-46		
Middle	1976	4-7 to 11-12	58-38	70-47	79-57	80-61	78-55	72-48	59-32	42-32
Fork	1977	4-6 to 11-9	66-34	73-48	80-56	83-57	75-57	69-48	52-36	43-34
Ofstedal	1978	4-11 to 11-8	59-38	73-52	77-49	83-62	80-58	76-46	57-35	42-32
West	1976	4-6 to 11-12	59-37	69-45	77-54	79-60	76-52	71-47	61-32	40-32
Fork	1977	4-6 to 11-9	65-40	73-47	78-54	83-58	78-54	74-46	51-33	44-34
Susag	1978	4-10 to 11-8	59-37	74-49	81-47	83-62	82-55	73-44	59-36	44-32

a - Data from USGS 1975, 1976, 1977

Table 2. Dissolved oxygen (mg/l) in the Poplar River drainage, July and August 1978.

Location	Date									
	7-18	7-19	7-21	7-24	7-25	7-28	8-3[a]	8-7	8-10	Mean
W. Fork - Susag	8.9	6.8	5.9	5.8	6.1	6.3	7.8 7.7	6.3	6.2	6.7
Main River-Paulsen	7.9	7.3	6.4	6.2	6.1	6.9	7.8 7.9	6.6	6.8	6.9
Mid.Fk.-Ofstedal	8.5	6.7	7.1	8.2	6.5	6.2	7.5 7.5	7.0	7.3	7.2
E.Fk.-Lower	8.6	6.4	5.7	6.2	5.2	5.8	7.2 7.3	5.9	5.6	6.3
E.Fk.-Cromwell	7.4	5.8	6.3	5.9	6.0	5.0	7.0 6.9	7.0	5.8	6.2
E.Fk.-Middle	3.0	7.7	4.4	3.8	2.8	3.2	6.8 6.8	5.7	4.4	4.6
E.Fk.-Upper Slab	8.2	8.1	11.2	9.6	8.9	7.9	10.4 10.2	8.9	7.8	9.0
E.Fk.-Base of Dam	-	-	6.6	2.9	6.2	7.8	11.3 6.5	3.5-5.5[b] 4.6[c]	3.1-3.6[b] 3.4[c]	5.8

a - Two samples separated by 50-75 feet taken at all stations this date.
b - Range of four samples separated by 50-75 feet.
c - Mean of four samples.

Winter dissolved oxygen was measured once during the winter of 1978-79 on January 25, 1979 (Table 3). Attempts to make measurements later in the winter were unsuccessful because of ice depths greater than 4 feet or because the stream was frozen to the bottom.

Table 3. Dissolved oxygen (mg/l) in the Poplar River drainage, January 25, 1979.

West Fork Poplar River - Susag	4.4
East Fork Poplar River - Lower	2.2
East Fork Poplar River - Cromwell	4.6
East Fork Poplar River - Middle	2.2
East Fork Poplar River - Upper Slab	0.1
East Fork Poplar River - Border	2.3
East Fork Poplar River - Base of Dam	8.6

Dissolved oxygen values recorded on January 25, 1979 (Table 3) were lower than values recorded on January 23, 1978. Values in 1978 were lower in February and March than in January (Stewart 1978), and caused a fish kill in the East Fork Poplar River. Although not measured, dissolved oxygen in February and March 1979 was probably lower than in January 1979, but no fish kill was noted. Streamflows in April and May 1979 were higher than in April and May 1978. These higher flows may have washed dead fish downstream because none were found in May 1979 on the banks of the East Fork.

Fish population estimates in the East Fork Poplar River will be made in fall 1979. This may show whether or not East Fork Poplar River game fish populations suffered any winter kill.

Bottom Fauna

Data for samples collected in March and June 1977 were given in an earlier report (Stewart 1978). Table 4 contains results of samples collected in November 1977.

The insect orders Ephemeroptera, Trichoptera and Diptera made up the majority of organisms in all but one sample on the East Fork Poplar River, which contained a large number of amphipods. Average numbers of organisms per square foot were high. Averages for all samples were the following: March - 615, June - 803, November - 965. Average number of organisms per square foot was less than 100 at two stations in March, but none of the stations in June and November averaged fewer than 200 organisms per square foot.

Organisms from all samples have been given to Mr. Mike Fillinger of Helena, Montana for identification. No results have been received as yet.

Fish Studies

Game Fish Distribution

Additional work has been done on game fish distribution since that reported by Stewart (1978). Northern pike were found in summer 1978 at all points sampled in the West Fork Poplar upstream to and including the Peerless sampling station. None were found upstream of this point. Northern pike were not present at the Peerless station in 1977. This species is probably not a year-round resident in this portion of the West Fork. Spring runoff may be required to allow northern pike to reach upstream points on the West Fork. This runoff was not present in 1977, but was in 1978.

Fish populations were also sampled in Cottonwood Creek, a West Fork tributary (see map, Figure 1). Small numbers of walleye were found at sampling locations distributed over the length of the drainage. No other game species were found. Nongame species in Cottonwood Creek are all found in the West Fork Poplar River.

Table 4. Number and volume (milliliters in parentheses) of macroinvertebrates collected in 1 square foot riffle samples for stations in the Poplar River drainage.

Date	Ephemer-optera	Diptera	Trich-optera	Amphi-poda	Anne-lida[b]	Mollusca[c]	Other[d]	Total
			East Fork Poplar River-Border					
11/7/77	0	285(.5)	105(1.4)	24(.2)	73(.4)	7(1.2)	1(T)[a]	495(3.7)
11/7/77	0	27(T)	4(T)	1(T)	29(.1)	4(.2)	0	65(.3)
11/7/77	0	499(.2)	76(.3)	413(7.5)	13(T)	30(6.5)	0	1031(14.5)
11/7/77	8(T)	212(.3)	480(8.8)	139(1.6)	16(.2)	43(5.2)	0	898(16.1)
11/7/77	1(T)	98(.2)	334(4.8)	154(6.0)	9(.2)	37(4.2)	0	633(15.4)
			East Fork Poplar River - Pittinger Bridge					
11/7/77	1(T)	158(.4)	430(4.2)	12(.2)	7(.2)	0	0	608(5.0)
11/7/77	2(T)	168(1.2)	413(5.4)	14(.3)	1(.3)	1(T)	0	599(7.2)
11/7/77	2(T)	578(.6)	1013(8.6)	9(.3)	7(.3)	3(T)	0	1612(9.8)
11/7/77	2(T)	363(1.6)	898(6.2)	26(.7)	6(.5)	0	0	1295(9.0)
11/7/77	58(.4)	276(1.6)	308(1.8)	144(1.5)	11(.3)	0	8(1.0)	805(5.6)
			Middle Fork Poplar River - Near Border					
11/7/77	12(T)	429(2.4)	99(.8)	36(2.8)	19(1.8)	0	3(T)	598(7.8)
11/7/77	30(T)	376(3.1)	67(1.2)	23(1.6)	9(1.2)	0	0	505(7.1)
11/7/77	5(T)	138(.4)	1053(15.4)	17(.7)	4(.2)	27(.5)	0	1244(17.2)
11/7/77	6(T)	236(1.6)	569(8.0)	7(.4)	6(.3)	0	0	824(10.3)
11/7/77	3(T)	124(.6)	1139(13.8)	22(1.5)	4(T)	0	0	1292(15.9)
			Middle Fork Poplar River - Ofstedal					
11/7/77	0	132(.4)	1024(13.0)	0	3(T)	0	0	1159(13.4)
11/7/77	1(T)	41(.2)	668(11.0)	0	8(T)	0	0	718(11.2)
11/7/77	0	50(.6)	865(11.3)	4(T)	0	4(.2)	0	923(12.1)
11/7/77	0	75(3.1)	1680(21.4)	3(T)	7(T)	0	0	1765(24.5)
11/7/77	1(T)	149(.7)	351(2.1)	5(T)	24(.2)	0	0	529(3.0)

Table 4. continued. Number and volume (milliliters in parentheses) of macroinvertebrates collected in 1 square foot riffle samples for stations in the Poplar River drainage.

Date	Ephemer-optera	Diptera	Trich-optera	Amphi-poda	Annelida[b]	Mollusca[c]	Other[d]	Total
			West Fork Poplar River - South of Peerless					
11/7/77	175(1.0)	129(.4)	443(4.8)	4(.6)	6(.4)	9(.2)	0	766(7.4)
11/7/77	77(.4)	295(.8)	46(.8)	5(T)	6(.8)	1(T)	0	430(2.8)
11/7/77	118(.8)	179(.6)	31(.3)	1(T)	8(1.1)	0	1(.8)	338(3.6)
11/7/77	466(4.4)	125(.2)	47(.4)	16(.6)	19(2.8)	5(2.0)	0	678(10.4)
11/7/77	142(1.2)	138(.6)	75(1.0)	10(.6)	2(T)	1(T)	1(T)	368(3.4)
			West Fork Poplar River - Susag					
11/3/77	233(1.2)	55(.2)	303(3.6)	2(T)	4(.4)	0	0	597(5.4)
11/3/77	30(.2)	36(.2)	516(4.2)	0	1(.1)	0	0	583(4.7)
11/3/77	123(.7)	24(T)	336(2.8)	2(T)	2(.2)	0	1(.3)	488(4.0)
11/3/77	53(.2)	33(T)	976(9.2)	0	1(T)	0	0	1063(9.4)
11/3/77	220(.8)	127(T)	1772(7.4)	3(T)	0	0	0	2122(8.2)
			Poplar River - Lund					
11/7/77	0	107(T)	1372(16.8)	9(T)	6(T)	0	0	1494(16.8)
11/7/77	0	96(.2)	4396(7.0)	1(T)	0	0	0	4493(7.2)
11/7/77	0	132(.2)	1639(22.0)	0	1(T)	0	0	1772(22.2)
11/7/77	1(T)	288(1.2)	1431(22.0)	120(1.1)	30(.3)	88(2.1)	2(.3)	1959(27.0)
11/7/77	2(T)	112(T)	3244(32.6)	4(T)	2(T)	3(T)	0	3367(32.6)

Table 4. continued. Number and volume (milliliters in parentheses) of macroinvertebrates collected in 1 square foot riffle samples for stations in the Poplar River drainage.

Date	Empeher-optera	Diptera	Trich-optera	Amphi-poda	Anne-lida[b]	Mollusca[c]	Other[d]	Total
			Poplar River - Paulsen					
11/3/77	9 (T)	167(.3)	121(1.0)	6(T)	2(T)	0	6(T)	311(1.3)
11/3/77	16 (T)	147(.3)	1232(8.0)	4(T)	0	0	0	1399(8.3)
11/3/77	30(.2)	808(1.4)	732(7.5)	4(T)	2(T)	0	0	1576(9.1)
11/3/77	25(.2)	485(.7)	465(4.1)	2(T)	2(T)	0	0	979(5.0)
11/3/77	18(T)	316(T)	705(3.5)	13(T)	0	0	0	1052(3.5)
			Poplar River - Crowley					
11/3/77	169(.8)	13(T)	521(3.0)	0	0	0	0	703(3.8)
11/3/77	94(.6)	30(T)	653(6.2)	0	0	0	0	777(6.8)
11/3/77	43(.5)	366(.7)	424(2.8)	2(T)	0	0	1(T)	836(4.0)
11/3/77	54(.4)	47(T)	343(1.4)	6(T)	0	0	0	450(1.8)
11/3/77	233(1.6)	190(T)	820(4.5)	3(T)	0	0	0	1246(6.1)

a - Trace; less than 0.1 ml.
b - Annelida consists of Hirudinea and Oligochaeta.
c - Mollusca consists of Gastropoda and Pelecypoda.
d - Includes Decapoda, Hemiptera, Neuroptera, Gordioidea.

The burbot (ling) is present in the lower several miles of the Poplar River. This species was not listed by Needham (1976a). It was captured in spring 1978 and may be a Missouri River migrant.

Fish Spawning

Walleye and northern pike were sampled during the April spawning season in 1978 (Table 5). Results were similar to those of 1977. Spawners both years were found in all of the forks and the main river. Walleye were concentrated around riffle areas at the head and tail of pools. Ripe females were found over periods that were a few days later in 1978 than in 1977; this was probably due to cooler April weather in 1978 than in 1977.

No game fish were found in the upper East Fork in April 1978, but large numbers of young-of-the-year northern pike were present here later in the year. Spring sampling either missed the spawners that were present or sampling was not done when the spawners were present in this portion of the East Fork.

There was considerable mortality of walleye and northern pike in the East Fork in late winter 1978. Forty-four dead walleye and six dead northern pike were found in April by walking approximately 2 miles of stream downstream from the Pittinger bridge. Only one live walleye was found in electrofishing approximately 3 miles of the East Fork downstream of the Pittinger bridge in April 1978 (Table 5). Over 100 walleye were captured in the same section in April 1977 (Stewart 1978). Late winter dissolved oxygen was sufficiently low to cause the fish kill (Stewart 1978). The situation was probably aggravated by extremely thick ice (over 4 feet in places) that left very little fish living area available. A few dead walleye and northern pike were found on the bank in April 1978 in other parts of the East Fork, but not in the concentrations found downstream of the Pittinger bridge.

Low numbers of game fish captured in April 1978 compared to April 1977 suggest winter mortality in the remainder of the drainage, as well as the East Fork. Numbers of walleye captured in April in the East Fork were 196 (1977) and 77 (1978); corresponding numbers for northern pike were 52 and 33, with similar effort in both years. For the remainder of the drainage, the numbers of walleye captured in April 1977 compared to April 1978 were 417 (1977) and 199 (1978); corresponding numbers for northern pike are 140 and 59, again with similar effort in the 2 years. Dissolved oxygen was measured intensively only in the East Fork, but it may have been low in the remainder of the drainage. Ice depths are known to have been similar.

Table 5. Total number of walleye and northern pike captured and numbers of fish in spawning condition, spring 1978.

Location	Date	Walleye			Northern Pike		
		Number Caught	Ripe Males	Ripe/Spent Females	Number Caught	Ripe Males	Ripe/Spent Females
East Fork Poplar River							
Upper Slab	4-11	0	0	0	0	0	0
Upper Slab	4-18	0	0	0	0	0	0
Cromwell	4-12	4	0	0	9	0	0
Cromwell	4-24	26	15	0	4	1	1
Cromwell	4-25	46	37	1	6	2	1
Lower	4-24	1	1	0	5	3	2
Near Mouth	4-20	0	0	0	9	3	5
Totals		77	53	1	33	9	9
Middle Fork Poplar River							
Near Border	4-21	5	4	1	6	2	3
Hagfeldt	4-11	48	15	0	4	3	0
Ofstedal	4-19	63	37	1	3	3	0
Near Mouth	4-20	4	1	0	2	2	0
Totals		120	57	2	15	10	3
West Fork Poplar River							
Susag	4-18	12	8	0	3	1	1
Lower	4-21	14	11	2	17	6	4
Totals		26	19	2	20	7	5
Upper Main Poplar River							
Lund	4-12	13	9	0	1	1	0
Lund	4-14	32	22	0	7	4	1
Paulsen	4-10	2	2	0	9	2	5
Paulsen	4-14	2	1	0	4	1	2
Crowley	4-10	4	1	0	3	2	1
Totals		53	35	0	24	10	9

Table 5 continued. Total number of walleye and northern pike captured and numbers of fish in spawning condition, spring 1978.

Location	Date	Walleye			Northern Pike		
		Number Caught	Ripe Males	Ripe/Spent Females	Number Caught	Ripe Males	Ripe/Spent Females
			Lower Main Poplar River				
Near Mouth	3-29	17	6	0	3	0	0
Near Mouth	3-30	10	0	0	6	0	0
Near Mouth	4-3	13	4	0	7	3	0
Near Mouth	4-5	5	1	0	3	1	0
Youpee to Mouth	4-6	11	4	0	9	4	4
Near Mouth	4-13	0	0	0	6	3	0
Murphy Slab	4-13	17	11	0	3	1	2
Murphy Slab to town of Poplar	4-17	58	45	2	11	3	3
Near Mouth	4-26	0	0	0	3	0	0
Youpee to Mouth	5-8	55	15	0	3	0	0
Totals		186	86	2	54	15	9
Grand Totals		462	250	7	146	51	35

Spawners were sampled in the lower river from the Murphy slab (Figure 1) to the mouth in April 1978. Results are shown in Tables 5 and 6. Ripe female northern pike were found earlier here than in upstream areas. The first ripe female northern pike in the lower river was found on April 6, 1978 as compared to April 14 for upstream locations. The lower portion of the drainage also had considerable numbers of sauger in spring (Table 6). These were not present in upstream portions of the drainage.

Table 6. Numbers of sauger captured in the lower Poplar River, spring 1978.

Location	Date	Number Caught	Ripe Males	Ripe or Spent Females
Near Mouth	3-29	14	2	0
Near Mouth	3-30	58	14	0
Near Mouth	4-3	27	5	0
Near Mouth	4-5	13	5	0
Near Town of Poplar	4-6	1	1	-
Near Mouth	4-13	1	1	0
Murphy Slab	4-13	1	0	0
Murphy Slab to Town of Poplar	4-17	3	0	0
Near Mouth	4-26	0	0	0
Youpee to Town of Poplar	5-8	10	3	0
Totals		128	31	0

Walleye and northern pike spawners captured in 1977 were aged from scale impressions. Male walleye spawned for the first time at age II. A few may not have become sexually mature until age III. Female walleye first ripened at age III. Male northern pike became ripe at age I. A few female northern pike probably spawned at age I, but most did not become sexually mature until age II.

Walleye Egg Sampling

Walleye eggs were found at all locations where spawners were found and on some riffles where spawners were not captured by electrofishing. Table 7 summarizes walleye egg data and associated physical parameters. Walleye eggs were found at other locations, but physical parameters were not measured. Numbers of walleye eggs on a given unit area of stream bottom are thought to be much greater than shown in Table 7. The eggs are rather adhesive; many eggs were probably not freed from the substrate to float into the egg basket.

Walleye eggs, almost without exception, were found in pool tail and riffle habitats and on gravel substrates. Streamflows at time of egg sampling varied from approximately 5 cfs at the East Fork-Cromwell station to approximately 200 cfs at the Poplar River-Youpee station. In spite of this, mean velocity of water over eggs among the five stations ranged only from 1.51 to 1.98 feet per second (Table 7). Walleye accepted shallower water for spawning in locations where streamflow was lower. Mean water depths in which eggs were found varied from 0.6 feet for the low streamflow station to 1.7 feet for the high streamflow station.

Table 7. Physical characteristics of sites where walleye eggs were found.

Location	Date	No. of Samples[a]	Substrate Size (Inches)	Mean and (Range) No. of eggs per Sample	Water Depth[b]	Water velocity at 0.6 of Depth[c]
Poplar River-Youpee	4-19-78	4	0.2-3.0	13 (4-20)	1.7 (1.2-2.0)	1.79 (1.47-2.10)
Poplar River-Crowley	4-27-78	20	Coarse sand to 6.0	6 (2-17)	1.25 (0.9-1.6)	1.98 (1.47-2.29)
Middle Fork Poplar-Ofstedal	4-28-78	13	Coarse sand to 6.0	4.6 (1-12)	1.1 (0.5-1.7)	1.79 (0.69-2.92)
East Fork Poplar-Cromwell	5-3-78	11	Coarse sand to 6.0	28.6 (7-70)	0.6 (0.4-0.8)	1.77 (0.7-2.56)
West Fork Poplar-Susag	4-27-78	17	Coarse sand to 6.0	7.1 (1-28)	0.9 (0.5-1.3)	1.51 (0.9-2.86)

a - Each sample consisted of approximately 5 ft^2 of streambottom.
b - Feet.
c - Feet per second.

Larval Fish Sampling and Early Life History

Larval fish differ from the adult or juvenile by lacking the adult body conformation and/or the full number of adult body parts (Hogue, Wallus and Kay, 1976). The pictoral fin is often used to distinguish larvae from juveniles as it is usually the last fin to develop the adult number of fin rays. Larval fish are usually subdivided by presence (prolarvae) or absence (postlarvae) of the yolk sac. All walleye sampled by larval nets in 1978 were in the larval stage with the exception of seven of eight walleye which were juveniles, captured on the East Fork on the last day of larval sampling, June 12. These fish are treated in data tables as larvae because of the method of capture and the short time since they had reached the juvenile stage. Walleye were found to have larval characteristics up to a size of approximately 24 mm total length.

Ripe female walleye were captured over the period April 17 to April 25, 1978 (Table 5). This probably corresponds closely to the spawning period. The later date was on the East Fork where ice breakup was late because of lower runoff streamflows. This resulted in slower warming of water and delayed walleye spawning. Larval fish were captured on the first sampling date (May 11), (Table 8) along with walleye eggs. The walleye were largely within the size range of 6.0-8.6 mm given by Priegal (1970) for newly hatched larvae. All but one of the larval walleye captured May 11 were in the prolarvae stage, which endures for only 3-5 days following hatching (Priegal, 1970). On the basis of the following information, walleye hatching began about May 8 which gives an approximate period of 18-20 days from spawning to hatching.

A summary of larval walleye captured in set and tow nets is shown in Table 8. Some sauger may be counted as walleye in Table 8 because no attempt was made to distinguish between larval sauger and walleye, and because some sauger were present in the lower river during the April spawning period.

Larval sampling was most effective during the early larval period. About 85% (623 of 733) of the larval walleye captured in samples were caught during the first week of the sampling period.

The relative efficiency of set nets vs. tow nets in sampling larval walleye is given in Table 9. Although only about 11% of the walleye were captured in tow nets, the efficiency of tow nets relative to set nets is higher than this because approximately four times as much water was sampled with set nets. For all samples the set nets were approximately twice as efficient in sampling larval walleye as were the tow nets (Table 9). On two of the forks tow nets were more efficient. For this reason future sampling will probably utilize both methods.

Table 8. Number of larval walleye captured by date and station in set and tow nets in 1978.

Date		East Fork				Middle Fork				Main River				West Fork	Totals
		Upper Slab	Middle	Cromwell	Lower	Border	McCarty	Hagfeldt	Ofstedal	Lund	Paulsen	Crowley	Youpee	Susag	
5-11	sets							4	0	1		101	151	36	293
	tows														
5-12	sets						8			0	2	66	45	9	130
	tows														
5-15	sets										0	10	90[a]	13	113
	tows														
5-16	sets					0	3	2	2	0					7
	tows														
5-17	sets	0	0	0	0						6	13	45		64
	tows										8	2	6		16
5-18	sets					0	1	2	0	1					4
	tows					0	2	21	1	0					24
5-19	sets										0	1	5	0	6
	tows										0	1	0	4	5
5-22	sets	0	0	0	0					0					0
	tows	0	0	0	0					0					0
5-23	sets					0	5	2	2					0	9
	tows					0	1	11	0					0	12
5-24	sets		0	0	0						2	0	0		2
	tows											0	0		0
5-25	sets	0	0	0	0	0	0	0	0	0	0	3	0	0	3
	tows														

Table 8 continued. Number of larval walleye captured by date and station in set and tow nets in 1978.

Date		East Fork				Middle Fork				Main River				West Fork	Totals
		Upper Slab	Middle	Cromwell	Lower	Border	McCarty	Hagfeldt	Ofstedal	Lund	Paulsen	Crowley	Youpee	Susag	
5-26	sets	0	0	0	0						0			0	0
	tows	0		0	0									0	0
5-30	sets					0	0	0	0	0					0
	tows														
5-31	sets		0	0	0						0	2		1	3
	tows														
6-1	sets	0				0	1	0	0		0				1
	tows														
6-2	sets	0	0	0	0						0			0	0
	tows	0	0	0	3						0			0	3
6-5	sets					0	4	3	0	0		0			7
	tows					0	2	4	3	0		0			9
6-6	sets	0	0	0	0						0			0	0
	tows	0	0	0	1						0			0	1
6-7	sets					0	0	2	0	0		0			2
	tows					0	0	4	0	0		0			4
6-8	sets	0	0	0	0						0			0	0
	tows	0	0	0	0						0			0	0
6-9	sets					0	4	3	0		0				7
	tows														

Table 8 continued. Number of larval walleye captured by date and station in set and tow nets in 1978.

Date		East Fork				Middle Fork				Main River				West Fork	To-
		Upper Slab	Mid- dle	Crom- well	Low- er	Bor- der	McCar- ty	Hag- feldt	Ofste- dal	Lund	Paul- sen	Crow- ley	You- pee	Susag	tals
	sets	0	0	0	0									0	0
6-12	tows	0	0	0	8[b]									0	8
To-	sets	0	0	0	0	0	26	18	4	2	10	196	336	59	651
tals	tows	0	0	0	12	0	5	40	4	0	8	3	6	4	82
Grand Totals:		East Fork - 12				Middle Fork - 97				Main River - 561				West Fork - 63	733

a - Includes 67 walleye larvae from the nearby USGS gage station.
b - Early juvenile

Table 9. Relative efficiency of set nets vs. tow nets in sampling walleye larvae.

Stream Fork	Number of Walleye Sampled		Water Volume Sampled (M^3)		Number of Larvae Per 1000 M^3		Larvae Per 1000 M^3 Combined Sets & Tows
	Sets	Tows	Sets	Tows	Sets	Tows	
East Fork	0	12[a]	7,607	6,181	0.00	1.94	0.87
Middle Fork	48	49	23,199	4,315	2.07	11.36	3.53
West Fork	59	4	11,177	1,894	5.28	2.11	4.82
Upper Main R[b]	208	11	24,905	4,157	8.35	2.65	7.53
Lower Main R[c]	336	6	7,753	1,053	43.34	5.70	38.84
All Samples	651	82	74,641	17,600	8.72	4.66	7.95

a - Includes seven early juveniles.
b - Down to and including the Crowley sampling sation.
c - Includes Youpee and USGS gage sampling stations near the town of Poplar.

Sampling efficiency was also examined with respect to time of day. Samples were collected during early morning and evening hours so that this analysis could be made (Table 10). It appears that sampling with set nets was most efficient during the middle of the day, but few early morning and evening samples were collected during the first week of sampling, when most walleye larvae were captured, so this may not be a valid conclusion. A series of one hour samples taken through a 24 hour period at one station would be required to show changes in sample efficiency. Also, fairly large numbers of walleye should be present in the samples. The 24 hour sample series was collected in 1977 (Stewart, 1978) but no larval walleye were captured.

Tow nets were more effective during early morning than mid-day or evening, but the differences were not large (Table 10).

Figure 2 shows growth of larval walleye through the sampling period. Time of hatching and growth rate on the West Fork, Middle Fork and Main River seem very similar. Although no early larvae were captured on the East Fork, the shape of the curve suggests that spawning was later and that growth was more rapid.

Table 10. Average number of walleye larvae per sample and number of samples (in parentheses) for various time periods of the day in May and June, 1978.

Stream Fork	Set Net Samples				Tow Net Samples			
	before 0600	0600-0800	0800-1800	after 1800	before 0600	0600-0800	0800-1800	after 1800
East Fork	-	0.0(2)	0.0(34)	0.0(3)	-	-	0.5(21)	0.31(3)
Middle Fork	3.0(1)	1.2(5)	1.2(3.3)	-	-	2.3(3)	3.0(14)	-
West Fork	-	-	4.9(12)	-	-	-	0.6(7)	-
Main River	0.0(2)	-	14.7(37)	0.0(2)	-	-	1.1(16)	0.0(1)
All Forks	1.0(3)	0.7(7)	5.6(116)	0.0(5)	-	2.3(3)	1.3(58)	0.3(4)

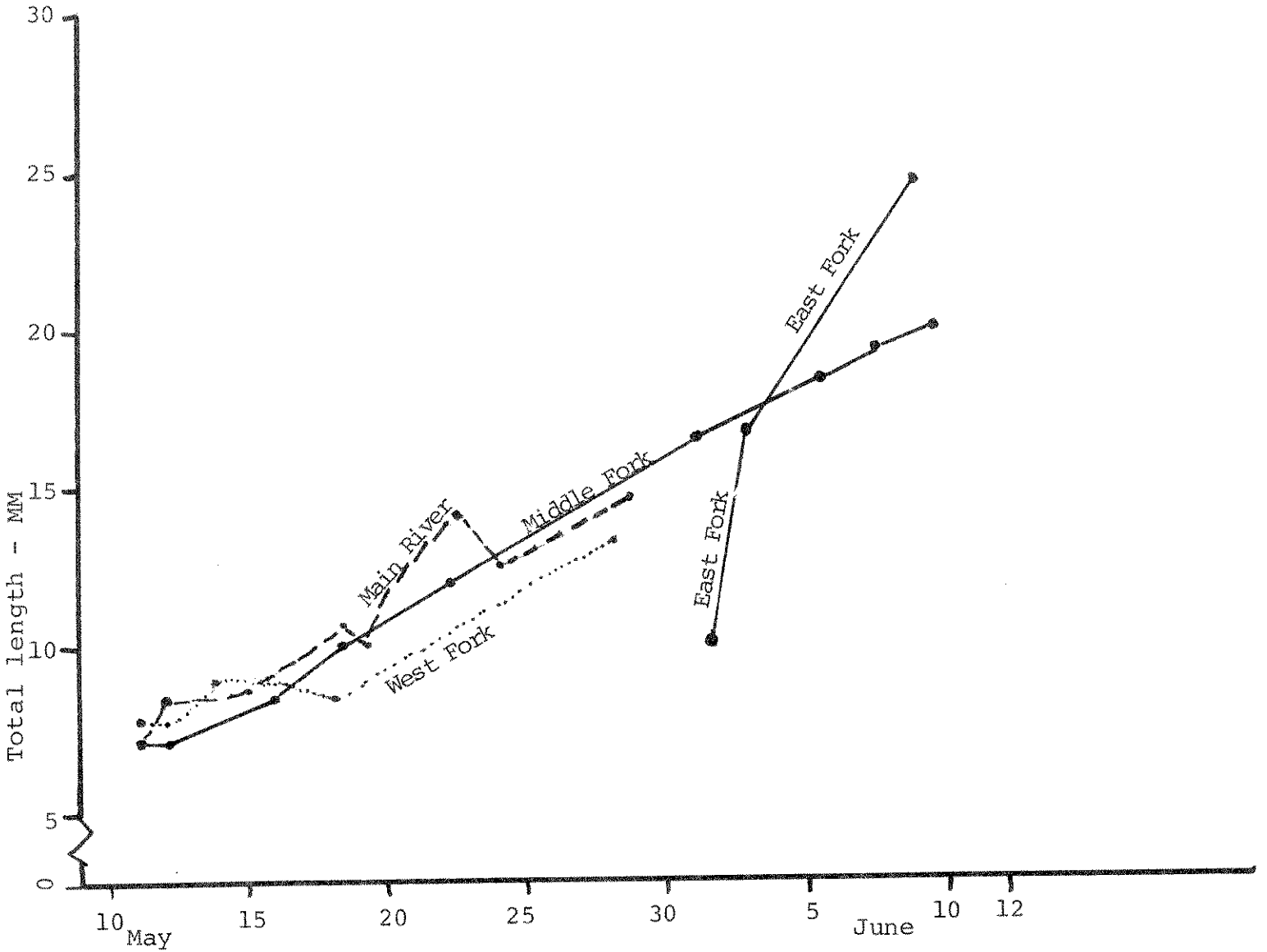

Figure 2. Weighted average total length of walleye larvae sampled at various dates in 1978.

No larval walleye were captured in set nets in 1978 on the East Fork Poplar River, and only 12 were captured in tow nets (Tables 8 & 9). This was somewhat surprising because two sections on the lower East Fork had numbers of young-of-the-year walleye late in 1978 similar to numbers found in other parts of the drainage. No young-of-the-year walleye were present in the upper East Fork late in 1978. The relative paucity of larval walleye in lower East Fork samples may have been due to much lower streamflows during the sampling period than in the rest of the drainage. The dam in Canada on the East Fork impounded all but very small flows during the larval sampling period. Flows may have been too low to move larval walleye out of pools and across riffles where larval nets were set.

A comparison of density of larval walleye in the Poplar River drainage between 1977 and 1978 is made in Table 11. For the whole drainage, larval walleye were approximately 28 times more abundant in 1978 than in 1977. The difference was somewhat less in the Middle and West Forks and somewhat greater in the Main River. Although only 12 walleye were captured in the East Fork in 1978, none were captured with considerably more sampling (Table 11) in 1977. These differences between 1977 and 1978 in larval fish were also true of young-of-the-year walleye late in the respective years. Three East Fork sections had average fall young-of-the-year estimates of 4 per mile in 1977 and 67 per mile in 1978. Fall young-of-the-year estimates in the remainder of the drainage were also higher in 1978. These will be discussed in more detail in a later section.

Table 11. Comparison of walleye larvae sampling in 1977 and 1978.

Stream Fork	Water Volume Sampled (M^3)		Number of Walleye Larvae		Number of Larvae/ 1000 M^3		Ratio -1978:1977 Number of larvae/ 1000 M^3
	1977[a]	1978	1977	1978	1977	1978	
East Fork	34,999	13,788	0	12[d]	0.00	0.87	-
Middle Fork	11,044	27,514	5	97	0.45	3.53	7.8:1
West Fork	3,356	13,071	4	63	1.19	4.82	4.1:1
Upper Main R[b]	16,161	29,062	3	219	0.19	7.53	39.6:1
Lower Main R[c]	5,463	8,806	8	342	1.46	38.84	26.6:1
Totals	71,023	92,241	20	733	0.28	7.95	28.4:1

a - Sampling by set nets only in 1977 but by set and tow nets in 1978.
b - Down to and including the Crowley sampling station.
c - Includes Youpee, USGS gage and Poplar sampling stations near the town of Poplar.
d - Includes 7 early juveniles.

Differences in streamflow are the most likely cause for the differences in walleye production between 1978 and 1979. April and May streamflows for the two years are compared in Table 12. 1977 was an exceptionally low runoff year and 1978 was somewhat above average. The Saskatchewan power corporation dam in Canada on the East Fork impounded runoff both years. However, on the lower half of the East Fork in the U.S. there was enough runoff entering the East Fork downstream of the dam to make March and April flows considerably greater in 1978 than in 1977. East Fork flows in May 1977 were considerably greater than in May 1978 because of water releases from the dam beginning about May 12. For the May 1-12 period East Fork flows were less in 1977 than in 1978 (Table 12). The water releases from the dam came too late because many walleye eggs present had hatched. In the remainder of the drainage in 1977 the low runoff produced lesser numbers of larval walleye than the larger runoff of 1978. In summary, production of larval walleye (and also of fall young-of-the-year) appears to be dependent on streamflows during the spawning and incubation period.

Table 12. Mean, maximum and minimum flows for the months of April and May, 1978 (1977 in parentheses) at four points in the Poplar River drainage.[a]

April			May		
Mean	Max.	Min.	Mean	Max.	Min.
	East Fork Poplar River Near International Boundary				
2.9(2.4)	3.6(2.9)	2.3(2.0)	3.0(17.1)[b]	3.7(58)	2.6(1.8)
	East Fork Poplar River Near Town of Scobey				
38(6.6)	125(11)	10(3.2)	8(17.9)[c]	10(164)	3(2.4)
	Middle Fork Poplar River Near International Boundary				
75.4(11.1)	709(15)	20(9.1)	25.6(12.4)	47(82)	12(4.3)
	Poplar River Near Town of Poplar				
681(122)	4630(210)	139(38)	150(31)	205(42)	100(27)

a - Data from USGS (1977) and USGS(1978), in press.
b - 2.2 cfs if only the first 12 days of May 1977 are considered.
c - 3.6 cfs if only the first 12 days of May 1977 are considered.

The large numbers of larval walleye captured in the lower Main River in 1978 (Table 9) may be the result of migrant Missouri River spawners. Two walleye spawners marked in the spring 1978 in the lower Poplar were caught by fishermen in Garrison Reservoir during the summer of that year. Missouri River spawner movement into the lower Poplar River will be the subject of future study.

Northern pike were also captured during the larval sampling period, but in much fewer numbers. A total of 21 northern pike were captured of which 12 were postlarvae and 9 were juveniles. No prolarvae were captured. During the first day following hatching northern pike larvae attach to vegetation by means of an adhesive organ (Machniak 1975). They usually remain in this position for 9 or 10 days following hatching. For this reason northern pike larvae are probably not vulnerable to larval nets during the early larval period.

Although only 21 northern pike were captured during the larval period in 1978 this number is considerably greater than the one that was sampled from a similar volume of water passed through nets in 1977. In view of the size of young-of-the-year northern pike populations formed by fall in 1977 and 1978, sampling for larval northern pike may be useful in predicting the size of year classes formed even with small larval sample sizes. The 1977 year class of northern pike essentially failed (average of 5 per mile in 7 stream sections in fall 1977) while a large year class was formed in 1978 (average of 134 per mile in 9 stream sections in fall 1978). Young-of-the-year northern pike population estimates are discussed further in the section on population estimates.

Large numbers of larval fish other than walleye and northern pike were also captured in set and tow nets in 1978. Several thousand larval fish of the family Catostomidae were sampled on each of the three forks and on the main river. Most of these were probably white sucker, but a positive identification was not made. Other larval fish collected included unidentified cyprinids, carp, Iowa darter and brook stickleback.

Fish Population Estimates

Estimates of numbers and weight of walleye and northern pike were made in seven stream sections in the Poplar drainage in 1977. Estimates for these same seven sections and for two additional sections were made in 1978. Detailed data for 1977 were shown in a previous report (Stewart 1978). Detailed data for 1978 are given in Appendix A.

Comparisons of 1977 to 1978 numbers per mile of walleye and northern pike are shown in Table 13. In the remainder of this report section comparisons of fish numbers between 1977 and 1978 are made using only stream sections where estimates were made for both years. The Crowley and Middle Fork-border sections are deleted because they were done only in 1978.

Table 13. Number per mile of walleye and northern pike in Poplar River stream sections in late 1977 and late 1978.[a]

Age Class	Walleye 1977	Walleye 1978	Northern Pike 1977	Northern Pike 1978
East Fork Poplar River - Upper Slab Section - 6,015 feet				
0+	11	0	0	415
I+	10	0	0	0
II+	3	0	0	0
III+ and older	0	0	1	1
East Fork Poplar River - Cromwell Section - 7,560 feet				
0+	3[b]	69	0	0
I+	6	24	74	5
II+	100	87	51	20
III+ and older	55	59	71	24
East Fork Poplar River - Lower Section - 10,010 feet				
0+	3[b]	134	1[b]	139
I+	22	10	8	0
II+	26	8	5[c]	4[c]
III+ and older	38	6	-	-
Middle Fork Poplar River - Border Section - 7,785 feet				
0+	- 51[b]	-	-	252
I+	- 33	-	-	17
II+	- 6	-	-	1
III+ and older	-	35	-	0
Middle Fork Poplar River - Hagfeldt Section - 8,240 feet				
0+	186	215	6[b]	101
I+	22	26	18[d,b]	18[d,b]
II+	53	26		
III+ and older	15	28		
Poplar River - Lund Section - 9,800 feet				
0+	37	65[b]	3[b]	92
I+	32	17	17	1
II+	24	23	29	27
III+ and older	23	20	17	32

Table 13 continued. Number per mile of walleye and northern pike in Poplar River stream sections in late 1977 and late 1978.[a]

Age Class	Walleye 1977	Walleye 1978	Northern Pike 1977	Northern Pike 1978
Poplar River - Paulsen Section - 10,990 feet				
0+	76	11[b]	28[b]	119
I+	25	26	23	11
II+	12	6	29	12
III+ and older	13	10	19	17
Poplar River - Crowley Section - 11,300 feet				
0+	-	122	-	122
I+	-	24	-	2
II+	-	6	-	14
III+ and older	-	11	-	8
West Fork Poplar River - Susag Section - 8,950 feet				
0+	61	189	0	92
I+	33	33	6[d,b]	5[d,b]
II+	14	3		
III+ and older	41	23		

a - Complete population data for 1978 is in Appendix A; complete population data for 1977 is found in Stewart 1978.
b - Statistical criteria not met; number is approximate.
c - Age II+ and older.
d - Age I+ and older.

Numbers in autumn of age 0+ northern pike were much larger in the East Fork and in the remainder of the drainage in 1978 than in 1977, probably because of considerably larger streamflows in April and May 1978. Average numbers per mile of age 0+ northern pike in the East Fork were less than one in 1977 and 185 in 1978. The corresponding numbers in the four sections in the remainder of the drainage were 9.3 and 101.

A large difference between the two years in age 0+ walleye was found only in the East Fork Poplar River. In 1977 there were 5.7 per mile (average for three stream sections), and 68 in 1978. In the remainder of the drainage the 1977 figure was 90, with 120 in 1978.

The preceding indicates that streamflows in the East Fork in spring 1977 were inadequate to produce substantial year classes of either walleye or northern pike, while 1977 April and May streamflows in the remainder of the drainage were sufficient to produce good year classes of walleye, but not northern pike. It appears that larger April-May flows are required for northern pike than for walleye. The flows in 1978 were adequate to form substantial year classes of both species in both the East Fork and the remainder of the drainage. For this reason April-May streamflows similar to those that occurred in 1978 were suggested as minimum instream flows (Montana Department of Fish & Game 1979).

Further evidence to substantiate the preceding conclusions can be seen by comparing the size of age I+ walleye and northern pike populations in 1978, which were formed from 1977 age 0+, to the size of age II+ populations in 1978 (Table 13). For northern pike, age I+ numbers in 1978 were generally less than age II+ in all parts of the drainage. The same is also true of walleye in the East Fork. For walleye in the remainder of the drainage numbers per mile of age I+ are generally greater than numbers of II+, indicating that spawning success and survival of age 0+ walleye was adequate in 1977 except in the East Fork.

Considerable winter mortality of walleye and northern pike during the winter of 1977-78 was noted by dead fish on the banks in April 1978 in the East Fork (Stewart 1978). Some mortality was also suspected in the rest of the drainage. The mortality apparently was severe only for northern pike in the East Fork Poplar River where numbers of age I+ and older fish decreased from an average of 70 per mile in 1977 to 18 per mile in 1978. The corresponding numbers for walleye on the East Fork are 86 and 65. For the remainder of the drainage (1977 given first) the numbers are 40 and 31 for northern pike and 77 and 60 for walleye. The 1978-79 winter was again severe, but no dead fish were found along the East Fork in spring 1979. Population estimates in fall 1979 will show the degree of mortality during winter 1978-79.

Movement and Migration

Game fish movement in most of the Poplar River was low in 1977 (Stewart 1978). Most fish seemed to spawn in the same locality occupied the remainder of the year. This was also true in 1978, although flows were much greater in 1978. Table 14 summarizes percentages of recaptured walleye and northern pike that moved from the point originally captured. Of 130 walleye recaptured in 1978, only 3(2 percent) had moved; the corresponding figures for northern pike were 80, 5 and 6 percent. Fish tagged in spring and fall 1977 were recaptured in both spring and fall 1978. Fall 1978 recapture was also made of fish tagged in spring 1978.

Table 14. Recapture in 1978 of fish tagged in 1977 and 1978.[a]

Number Recaptured		No movement from location tagged				Moved from location tagged			
		Walleye		N. Pike		Walleye		N. Pike	
Walleye	N. Pike	No.	%[b]	No.	%[b]	No.	%[b]	No.	%[b]
		Recaptured in East Fork Poplar River							
50[c]	37[d]	49	98	34	92	1	2	3	8
		Recaptured in Middle Fork Poplar River							
30	6	29	97	6	100	1	3	0	0
		Recaptured in West Fork Poplar River							
18	6	18	100	5	80	0	0	1	20
		Recaptured in lower main river - Murphy Slab to Mouth							
11	2	11	100	2	100	0	0	0	0
		Recaptured in upper main river - East Fork to Crowley Slab							
21	29	20	95	28	97	1	5	1	3
		Totals							
130	80	127	98	75	94	3	2	5	6

a - Includes both electrofishing and angler recapture.
b - Percent of number recaptured.
c - Includes 27 tagged walleye found dead on East Fork streambank in April 1978.
d - Includes 4 northern pike found dead on East Fork streambank in April 1978.

Spawners were captured in the lower Poplar River (Murphy Slab to mouth) in spring 1978. Considerable numbers of sauger were present here at this time (Table 6). Considerably larger numbers of sauger were caught in late March and early April than in late April (Table 6). These sauger may be quite migratory. Many of them may spawn in the Poplar River and reside outside the drainage at other times of the year. Of seven sauger recaptured, over 50 percent (4) had moved. One sauger marked in 1977 in the West Fork Poplar River and one marked in 1977 at the Paulsen location on the upper main river were both recaptured in the lower main river in spring. Another sauger marked in summer on the Yellowstone River near Fallon was caught in spring on the lower Poplar. The fourth recaptured sauger was marked in the lower Poplar in early April 1978 and recaptured later in the year on the Yellowstone River near Miles City.

Two walleye marked in spring in the lower Poplar River were recaptured later in the year in Garrison Reservoir in North Dakota. No fish from upstream portions of the Poplar River drainage were ever recaptured outside the system. The lower Poplar River may have significant spawning runs of both sauger and walleye, but sufficient field work has not yet been done to determine this.

Table 15 is a summary of game fish movement. No significant spawning movements appear likely other than those already described.

Fish for Metals Analysis

Small samples of fish for analysis of muscle tissue for metals were collected in June 1978. Samples were collected of both walleye and northern pike and frozen the same day. These fish were sent to Denver on dry ice by air freight for analysis at the Denver EPA laboratory. No results have been received as yet. Results will be shown in a future report.

Minimum Instream Flows

Tentative minimum instream flows have been formulated for the Poplar and Redwater Rivers. These flows are shown along with instream flows for other streams in the Missouri River drainage in a recent report (Montana Department of Fish and Game 1979). Poplar River field data from 1979 will be used to improve the instream flow determinations. Application may be made to the State of Montana, Department of Natural Resources, for an instream flow reservation for the Poplar River.

Table 15. Movement of Poplar River walleye (WE), northern pike (NP) and sauger (S) from one location to another.

Location Recaptured		Location Tagged					
		East Fork	Middle Fork	West Fork	Upper Main River	Lower Main River	Outside Drainage
East Fork	WE	-	0	0	1	0	0
	NP	-	0	0	4	0	0
	S	-	0	0	0	0	0
Middle Fork	WE	0	-	0	1	0	0
	NP	0	-	0	1	0	0
	S	0	-	0	0	0	0
West Fork	WE	0	0	-	0	0	0
	NP	0	0	-	1	0	0
	S	0	0	-	0	0	0
Upper Main River	WE	0	2	0	-	0	0
	NP	1	0	0	-	0	0
	S	0	0	0	-	0	0
Lower Main River	WE	0	0	0	0	-	0
	NP	0	0	0	0	-	0
	S	0	0	1	1	-	1
Outside Poplar River Drainage	WE	0	0	0	0	2	-
	NP	1	0	0	0	2	-
	S	0	0	0	0	1	-

REDWATER RIVER

Fish populations were investigated in the Redwater River because large amounts of strippable coal are present in the watershed. Industry plans for coal mining and related development have been made public, but no exact timetables are known.

The Redwater River is a small prairie stream in Eastern Montana (Figure 3). It empties into the Missouri River near the town of Poplar. Much of the river consists of long pools up to several feet deep with short infrequent riffles. The Redwater drains rolling prairie with considerable rangeland and some dryland farming. Streamflow is highly variable through the year and from year to year. Streamflows may vary from zero to several thousand cubic feet per second.

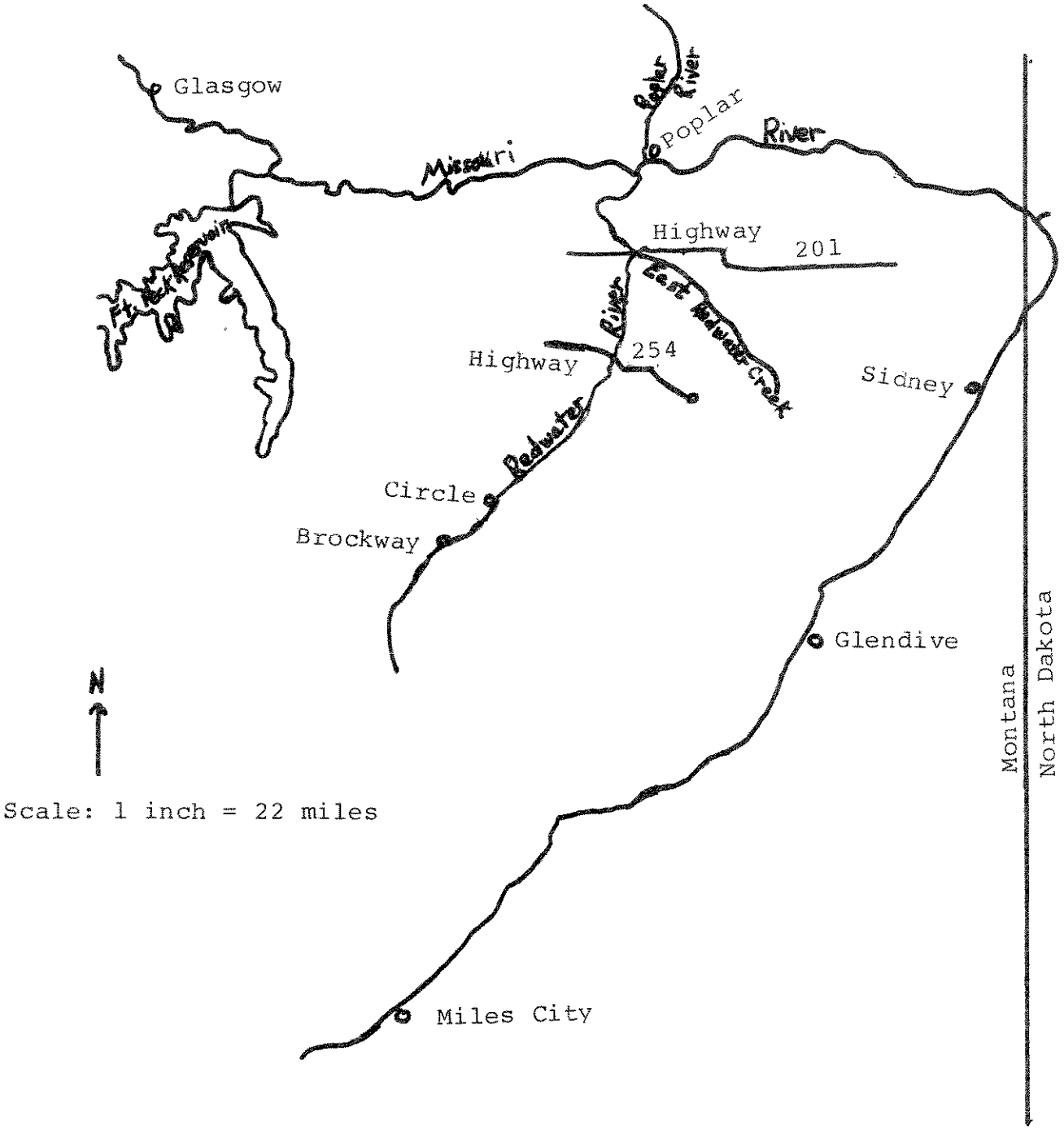

FIGURE 3. Map of a portion of Eastern Montana showing the Redwater River.

Fish species composition of the Redwater River is given by Needham (1976B), who found 22 species. Most of these are small cyprinids. An additional three species were found in 1978, but only near the mouth. These are the sauger, burbot and channel catfish.

Of the gamefish only northern pike were found as far upstream as the town of Circle (Table 16). Numbers appeared to be low there. Somewhat larger numbers, including young-of-the-year (Table 16), are present from the Highway 254 bridge downstream, indicating northern pike spawning in this reach of the river.

Walleye were found from the East Redwater Creek to the mouth (Table 16). Numbers appeared to be fairly low. Only a single young-of-the-year was found. This was near the mouth; none were found at upstream points. There is probably very little walleye reproduction in the Redwater River.

Channel catfish, burbot and sauger were found only in a one mile section near the mouth. These species are probably migrants from the Missouri River.

Table 16. Game fish captured by seining and electrofishing in the Redwater River, 1978.

Location[a] and Date	Sauger		Walleye		Northern Pike		Burbot		Channel Catfish	
	adult	age 0+	adult	age 0+	adult	age 0+	adult	age 0+	adult	age 0+
Near Mouth 4-4	9	0	3	0	6	0	8	0	1	0
Near Mouth 8-30			1	1	3	2			8	0
Near Mouth 10-25	2	0	3	0	2	0	1	0		
201 Bridge 7-10			1	0	2	2				
201 Bridge 10-26			6	0	9	4				
254 Bridge 7-11					1	13				
Near Circle 7-11					2	0				
Near Brockway 7-19	No game fish captured									

a - See map (Figure 3) for locations.

BIG MUDDY CREEK

Big Muddy Creek originates in southern Saskatchewan and reaches the Missouri River a few miles west of Culbertson, Montana (see map Figure 4). It is the next major drainage east of the Poplar River. Periodicity of streamflows is similar to the Poplar River, but Big Muddy Creek differs in having few riffles. Fish population investigations were made because of an application by Farmers Potash Company to the Montana Department of Natural Resources and Conservation to dam Beaver Creek, a principal Big Muddy Creek tributary. The application specified water use of up to 7,500 acre-feet per year. Withdrawal would be farther downstream on Big Muddy Creek near the town of Redstone. From here water would be piped east to Daniels County and used in the mining and production of potash.

Game fish populations in Big Muddy Creek are limited to several miles of stream near the mouth (Table 17). Walleye, sauger, burbot, northern pike, channel catfish and shovelnose sturgeon were found in small numbers near the mouth. At approximately 10 river miles upstream of the mouth a single northern pike was seen but not captured in a 2 mile long electrofishing section. The only game fish captured farther upstream was a single yellow perch near the town of Reserve. No game fish were found in any portion of the drainage farther upstream (Table 17). A total of 11 locations in the drainage were sampled. Upstream portions of Whitetail Creek have been planted with brook trout. Reports from fishermen indicate the species is still present, but no sampling was done in portions of the stream where this species is present.

At least 20 fish species were found in the Big Muddy Creek drainage (Table 18). No attempt was made to distinguish between silvery and plains minnows. Either or both of these may be present. All of these fish species are common or abundant in northeastern Montana.

The proposed dam and reservoir on Beaver Creek and water withdrawal farther downstream on Big Muddy Creek will probably not be harmful to the small game fish populations present in the downstream portions of the stream. These game fish receive little attention from anglers and may be only incidental migrants from the Missouri River.

Table 17. Game fish captured in Big Muddy Creek drainage, 1978.

Date	Location[a]	Species	Number Captured	Range Length (inches)	Range Weight (pounds)	Approximate Stream Distance Electro-fished (E) or Seined(S)
3-31	Big Muddy Ck near mouth	Walleye	3	12.7-15.6	0.61-1.07	3 miles (E)
		Sauger	2	13.4-16.0	0.67-1.12	
		Burbot	2	15.2-20.5	0.85-2.04	
		Northern Pike	1	23.2	2.48	
		Shovelnose Sturgeon	1	27.5	2.29	
6-22	Big Muddy Ck near mouth	Walleye	1	seen-not captured		3 miles (E)
		Channel Catfish	2	seen-not captured		
6-22	Big Muddy Ck 5 miles north of Highway #2 -		1	northern pike seen but not captured		2 miles (E)
7-24	Big Muddy Ck near town of Froid		No game fish seen or captured			1 mile (E)
7-24	Big Muddy Ck near town of Reserve	Yellow Perch	1	10.2	0.56	1 mile (E)
6-21	Big Muddy Ck 6 miles East of town of Redstone		No game fish seen or captured			1.5 miles(E)
6-20	Big Muddy Ck near town of Daleview		No game fish seen or captured			600 ft. (S)
6-21	Big Muddy Ck 8 miles No. of Redstone		No game fish seen or captured			1 mile (E)
6-20	Whitetail Ck 2 miles upstream of mouth		No game fish seen or captured			450 ft. (S)
6-20	Beaver Ck near mouth		No game fish seen or captured			300 ft. (S)
6-20	Beaver Ck 2 miles upstream of mouth		No game fish seen or captured			300 ft. (S)
6-20	Beaver Ck--halfway between mouth and Canadian Border		No game fish seen or captured			300 ft. (S)

a - Locations listed from downstream to upstream

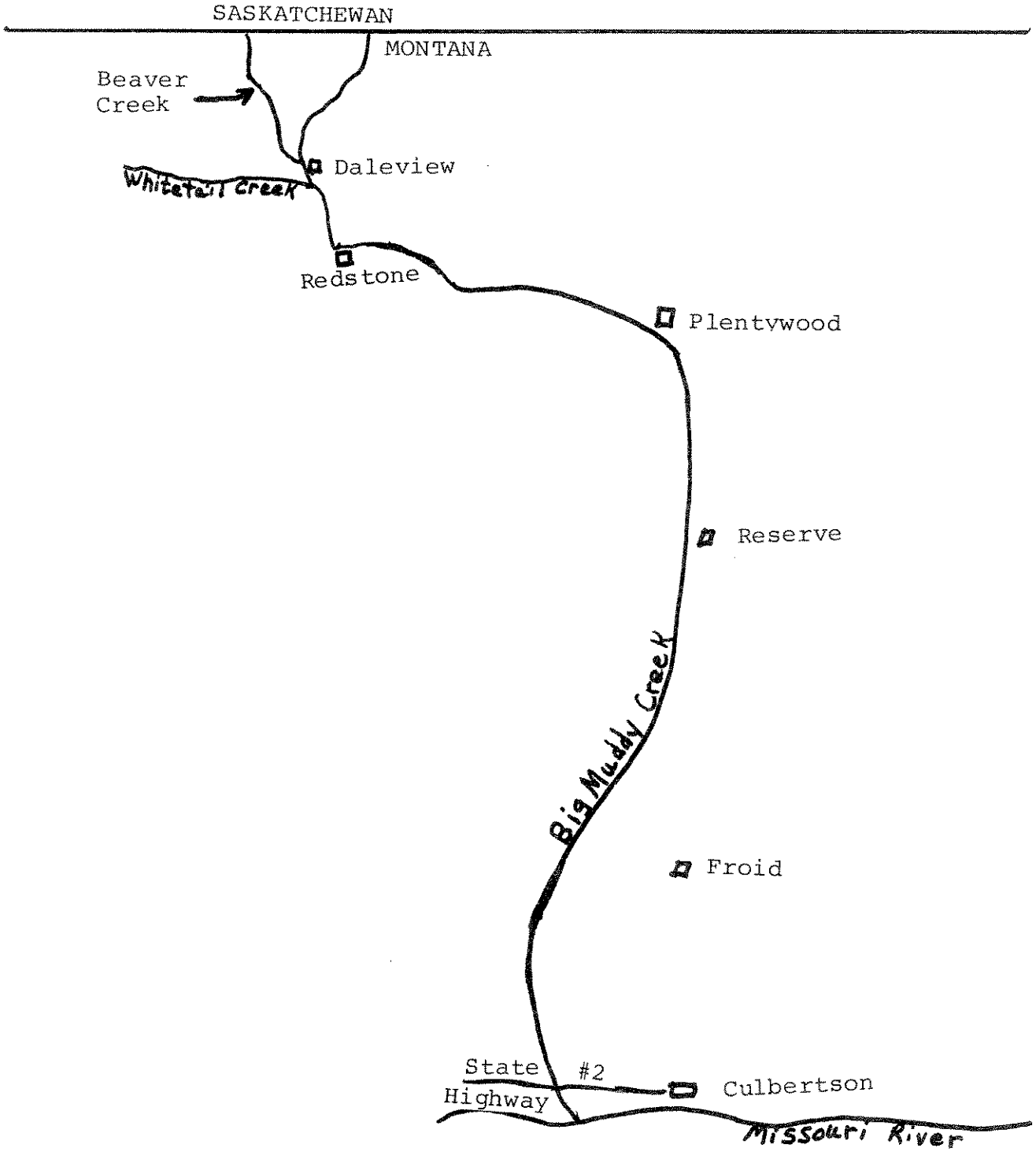

FIGURE 4. Approximate map of Big Muddy Creek drainage.

Table 18. Fish species found in the Big Muddy Creek drainage.

Fish Species	Big Muddy Creek - mouth to town of Froid	Big Muddy Creek - upstream of town of Froid	Whitetail Creek	Beaver Creek
Shovelnose sturgeon	X			
Goldeye	X			
Northern pike	X			
Carp	X	X		
Northern redbelly dace				X
Lake chub		X	X	X
Plains/Silvery minnow[a]		X		X
Fathead minnow		X	X	X
Longnose dace		X	X	X
River carpsucker	X			
Shorthead redhorse	X	X		
White sucker	X	X		X
Black bullhead	X			
Channel catfish	X			
Burbot	X			
Brook stickleback		X	X	X
Yellow perch		X		
Sauger	X			
Walleye	X			
Iowa darter		X		X

a - May include either species. These two were not distinguished.

MISSOURI RIVER

Project emphasis in April 1979 shifted from the Poplar River to the Missouri River from the Ft. Peck dam to the North Dakota border. This is a 185 mile reach of the River. Data on the Missouri River are not yet in report form. They will be given in a future report.

During part of April and most of the month of May, game fish were captured by electrofishing to determine distribution and relative abundance. These fish were also tagged to obtain information on movement. A total of 520 game fish was captured and tagged. Sauger appear to be the most abundant game fish as they made up over 60% of the total. Other species tagged included walleye, northern pike, burbot, channel catfish, shovelnose sturgeon and paddlefish. The paddlefish appears to be abundant, as 96 were sighted, of which 28 were tagged.

Sampling for larval fish began in late May to determine reproductive success of the various species and spawning locations. Larval fish were captured but no identification has been made.

RECOMMENDATIONS

Baseline information on the Poplar River is sufficient for the present time. Future activities here should consist of monitoring fish populations in the East Fork and Middle Fork (unmodified situation to serve as a control).

Project emphasis should be placed on the Missouri River from Fort Peck dam to the North Dakota border. This 185 mile reach has received very little study and needs of fish populations are, as a result, practically unknown.

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LIST OF WATERS REFERRED TO

Poplar River 6-16-2820-02
West Fork Poplar River 6-16-4060-02
Middle Fork Poplar River 6-16-2375-02
East Fork Poplar River 6-16-1415-02
Big Muddy Creek 6-16-0280-02
Redwater River 6-16-2940-10
Missouri River 6-16-2420-02

Prepared by:

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June 1979

Appendix A. Walleye and northern pike population data for stream sections in the Poplar River, late August to late October 1978.

Age Class	Mean Length (inches)	Mean Weight (pounds)	Estimated Number	Estimated Weight (pounds)	Fish Marked	Fish in Recapture Sample	Marked Fish in Recapture Sample
East Fork Poplar River - Upper Slab Section - 6,015 feet - Northern Pike							
0+	11.6	0.40	473	187			
I+ and older	26.8	4.58	1	7.6			
Totals			474 (114)[a]	191.6(49)	110	101	21
East Fork Poplar River - Cromwell Section - 7,560 feet							
			Walleye				
0	5.5	0.06	98	5.4			
I+	9.8	0.32	34	11.0			
II+	12.9	0.70	124	87.0			
III+ and older	14.8	1.07	84	89.4			
Totals			340(±54)	192.8(±43)	124	142	56
			Northern Pike				
0	None Captured		0	-			
I+	20.2	1.94	7	13.3			
II+	22.0	2.57	28	72.7			
III+ and older	27.8	5.54	34	187.8			
Totals			69(±14)	273.8(±47)	33	46	23
East Fork Poplar River - Lower Section - 10,010 feet							
			Walleye				
0	5.8	0.06	255	16.1			
I+	10.2	0.34	19	6.4			
II+	11.9	0.53	16	8.5			
III+ and older	15.6	1.27	11	13.5			
Totals			301(±50)	44.5(±5)	131	92	44
			Northern Pike				
0	9.8	0.23	265	60.6			
I+	None captured		0	-			
II+ and older	26.2	4.98	8	38.6			
Totals			273(±63)	99.2(±15)	96	75	31

a - 80% confidence interval

b - statistical criteria not met, estimate is approximate.

Appendix A continued. Walleye and northern pike population data for stream sections in the Poplar River, late August to late October 1978.

Age Class	Mean Length (inches)	Mean Weight (pounds)	Estimated Number	Estimated Weight (pounds)	Fish Marked	Fish in Recapture Sample	Marked Fish in Recapture Sample
Middle Fork Poplar River - Border Section - 7,785 feet							
			Walleye				
0[b]+	4.0	0.02	75[b]	1.3			
I+	8.1	0.15	49	7.4			
II+	10.1	0.30	10	2.9			
III+ and older	13.9	0.84	51	43.1			
Totals			185 (±36)	54.7 (±8)	93	82	47
			Northern Pike				
0+	7.9	0.13	370	48.4			
I+	16.4	1.03	25	25.3			
II+	18.6	1.74	1	2.0			
III+ and older	None captured		0	-			
Totals			396 (±29)	75.7 (±7)	227	224	128
Middle Fork Poplar River - Hagfeldt Section - 8,240 feet							
			Walleye				
0+	4.2	0.02	335	8.0			
I+	7.8	0.12	41	5.0			
II+	10.1	0.31	40	12.4			
III+ and older	14.1	1.04	43	45.3			
Totals			459 (±121)	71.7 (±7)	116	139	55
			Northern Pike				
0+	7.3	0.09	158	14.3			
I+ and older[b]	17.4	1.37	28[b]	38.9			
Totals			186 (±64)	53.2 (±21)	35	55	9

Appendix A continued. Walleye and northern pike population data for stream sections in the Poplar River, late August to late October 1978.

Age Class	Mean Length (inches)	Mean Weight (pounds)	Estimated Number	Estimated Weight (pounds)	Fish Marked	Fish in Recapture Sample	Marked Fish in Recapture Sample
Poplar River - Lund Section - 9,800 feet							
			Walleye				
0+[b]	4.5	0.04	121[b]	4.8			
I+	8.8	0.19	32	5.9			
II+	10.6	0.37	42	15.6			
III+ and older	15.4	1.29	38	48.7			
Totals			233 (±20)[c]	75.0 (±15)[c]	71	67	25
			Northern Pike				
0+	7.8	0.10	171	17.7			
I+	14.8	0.63	2	1.2			
II+	21.5	2.22	50	111.3			
III+ and older	26.5	4.84	59	285.3			
Totals			282 (±54)	415.5 (±108)	102	72	25
Poplar River - Paulsen Section - 10,990 feet							
			Walleye				
0+[b]	5.1	0.04	23[b]	0.9			
I+	10.0	0.29	54	15.9			
II+	11.0	0.39	13	5.0			
III+ and older	14.9	1.11	22	24.0			
Totals			112 (±13)[c]	45.8 (±8)[c]	65	50	28
			Northern Pike				
0+	8.8	0.15	247	37.4			
I+	15.5	0.75	23	17.3			
II+	20.4	1.75	25	43.2			
III+ and older	23.7	3.37	35	117.1			
Totals			330 (±40)	215.0 (±42)	183	91	51

c - Confidence interval is for age I+ and older only.

Appendix A continued. Walleye and northern pike population data for stream sections in the Poplar River, late August to late October 1978.

Age Class	Mean Length (inches)	Mean Weight (pounds)	Estimated Number	Estimated Weight (pounds)	Fish Marked	Fish in Recapture Sample	Marked Fish in Recapture Sample
Poplar River - Crowley Station - 11,300 feet							
Walleye							
0+	5.6	0.06	261	14.4			
I+	10.3	0.33	52	17.4			
II+	12.2	0.54	14	7.4			
III+ and older	16.1	1.55	24	37.1			
Totals			351(±94)	76.3(±11)	85	139	47
Northern Pike							
0+	9.9	0.21	261	55.6			
I+	16.6	0.96	4	4.0			
II+	20.2	1.76	30	52.6			
III+ and older	23.8	3.01	17	51.3			
Totals			312(±34)	163.5(±26)	139	170	75
West Fork Poplar River - Susag Section - 8,950 feet							
Walleye							
0+	5.8	0.06	322	18.7			
I+	9.6	0.25	56	13.9			
II+	11.4	0.40	5	2.1			
III+ and older	16.5	1.57	39	60.4			
Totals			422(±69)	95.1(±9)	172	177	97
Northern Pike							
0+	11.2	0.32	92	28.0			
I+ and older	23.1	2.89	5	14.5			
Totals			97(±21)[d]	42.5(±6)[d]	41	52	22

d - Confidence interval is for age 0+ only.