MONTANA DEPARTMENT OF FISH AND GAME
ECOLOGICAL SERVICES DIVISION

JOB PROGRESS REPORT

State Montana Title Lower Missouri River Basin

Project Number FW-2-R-7 Investigation

Job Number 1-b Title Planning Inventory, Fisheries

Period Covered July 1, 1977 through June 30, 1978

ABSTRACT

Fisheries and fisheries-related aquatic studies were undertaken on the Poplar River to obtain information for determining impacts of a coal-fired electrical generation complex being constructed in Saskatchewan on the East Fork Poplar River. Allocation of the waters of the basin between Canada and the U. S. has not been fixed, but flows in the East Fork have already been altered by filling of a reservoir on the East Fork in Saskatchewan.

Stream channel measurements were made to document width and depth. Very little of the stream is deeper than 4 feet at low streamflows. In winter 1977-78 much of the stream froze to the bottom. Thermograph measurements indicate that summer maximum temperatures are near 80 F. Winter dissolved oxygen is low in the East Fork. There was a winter fish kill in 1978 because of dissolved oxygen values as low as 0.1 ppm.

Quantitative riffle bottom fauna samples were collected at nine stations in late March, late June and early November. The insect orders Diptera, Trichoptera and Ephemeroptera dominated. Identification of organisms in samples has begun.

Walleye and northern pike are the dominant game fish. They occupy all of the drainage except the middle and upper portions of the West Fork. Game fish spawning locations were determined by capturing spawners. All portions of the drainage occupied by walleye and northern pike were used for spawning. Fish tag returns indicated that these species do not migrate to spawn, but probably utilize spawning habitat within home ranges.

Walleye eggs on the streambottom were sampled to pinpoint spawning locations and determine physical requirements for spawning. The data have not been analyzed yet. Walleye spawned principally in riffles. Northern pike eggs were not found. Numbers of larval walleye captured in nets set in riffles in 1977 were low. No larval walleye were found in the East Fork, indicating an early failure of the 1977 year class.

Walleye population estimates were made for seven stream sections in 1977; northern pike estimates were made in four of these sections. Most sections had approximately 100-200 walleye per mile. Age 0+ walleye and northern pike we virtually absent late in 1977 in the East Fork. Age 0+ walleye were present

in numbers sufficient to sustain existing populations, and age 0+ northern pike were low compared to older age groups in other portions of the drainage.

BACKGROUND

The Poplar River, a Missouri River tributary, is one of the better warm water fishing streams in Montana. It is a low gradient, sinuous prairie stream consisting of long pools and short riffles. The drainage consists of three major forks (Figure 1), all of which originate in Saskatchewan. Streamflow is often high in spring and relatively low the rest of the year. Gravel and sand are the dominant streambed materials, except in certain portions of the East Fork, where silt and mud bottoms are common.

In 1974 the Saskatchewan Power Corporation announced plans to construct a coal-fired electrical generation complex on the East Fork Poplar River, approximately 2 miles north of the U. S. border. An earthfull dam has been constructed on the East Fork which, when full, will inundate 1780 acres and store 32,000 acre feet of water (Poplar River Task Force 1976). It will serve as a cooling pond for one 300 megawatt plant presently under construction. The complex may eventually include an additional three 300 megawatt plants, although the natural flow of the East Fork is insufficient for operation of a four-plant complex. Importation of water to the East Fork basin would be required.

A plan to divide the flow of the Poplar River drainage between Canada and the U.S. has been developed (Poplar River Task Force 1976). Implementation of this plan has been delayed to allow consideration of water quality effects of the power development by a new international group under the International Joint Commission. The major provisions of the plan include: delivery of 50 percent and 60 percent, respectively, of the flows of the West and Middle Forks to the U.S. at the international boundary; minimum flows of 1, 2 or 3 cfs on the East Fork, depending on the magnitude of the spring flow each year in the Middle Fork. In addition Canada will deliver, on the East Fork, varying amounts of water to be released on demand. The yearly amount also will vary depending on the magnitude of the spring flow in the Middle Fork.

Unless the water to be released on demand is passed during spring, spring flows on the East Fork will be drastically reduced. At this time, while the reservoir is being filled, flow of the East Fork consists only of seepage from the base of the dam. The proposed large scale changes in the flow regime of the Poplar River, and especially in the East Fork, threaten fish populations. In its present condition large portions of the Poplar River supply fish habitat only slightly better than other prairie streams that do not support game fish.

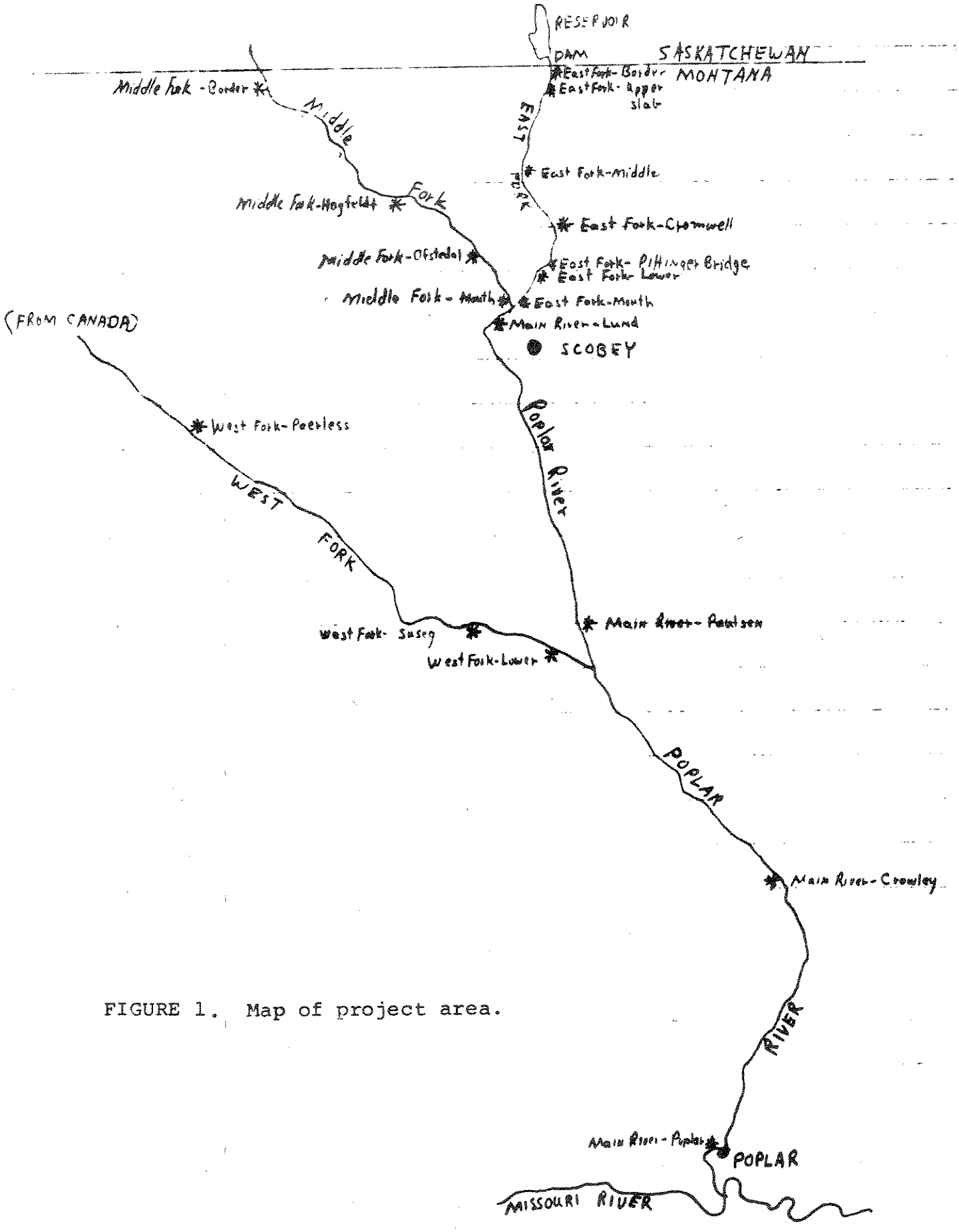

FIGURE 1. Map of project area.

Fisheries studies were begun in the Poplar River in 1975 (Needham 1976). Walleye and northern pike are the dominant game fish, although neither are native to the drainage. Smallmouth bass, introduced in 1967, and sauger are also present in the lower portions of the drainage. Distribution of forage fish is shown by Needham (1976). Other game species are found in the lower few miles of the Poplar River.

OBJECTIVES

The long-range goal of this study is to quantitatively understand the game fish populations of the Poplar River and the associated biological communities and physical and chemical habitat which support game fish populations. More immediate objectives toward this goal are the following:

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

B. Assemble and assimilate existing water quality and streamflow records and relate these to fish populations;

C. Measure winter dissolved oxygen at key locations;

D. Collect quantitative samples of riffle invertebrates, sort to appropriate taxonomic groups and make arrangements to have the organisms identified;

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

F. Locate spawning areas by electrofishing for spawners and by capturing larval fish with drift nets set in riffles;

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

H. Monitor stream temperature in the West and Middle Forks (East Fork temperature measurements by USGS).

PROCEDURES

Stream Channel Measurements

Channel widths and depths were measured at transects 100 feet apart in sections from 1.5 to 2.0 miles long. These same sections were also used for estimating fish populations. A metal tape was used to measure distance between transects and section length. At each transect a polypropylene rope, calibrated in feet, was stretched across the river and anchored at both banks. Width was read from

the rope. Depths were measured with a Philadelphia rod at an interval fixed for each transect, so that at least 12 and usually 15-20 depth measurements were made at each transect. Depths were measured by wading, or at deeper transects from a rubber tube equipped with a seat.

Stream Temperature

Thirty-day continuous recording thermographs were used to measure water temperature. The recorder was placed in a locked metal box as far above the water level as possible. The sensing element and lead were enclosed in a flexible plastic pipe. The pipe end containing the sensing element was anchored to the stream bottom in a riffle. The remainder of the pipe was anchored to the bank.

Dissolved Oxygen

Dissolved oxygen was measured by the Winkler method using powdered field reagents and PAO titrant. Where depths were sufficient water samples were collected with a Kemmerer sampler. In riffles sample bottles were filled by dipping.

Bottom Fauna

Riffle invertebrate samples were collected with the "Water's Round" square foot sampler (Waters and Knapp 1961). Five samples were collected at each station and preserved in the field in 80 percent ethyl alcohol. Shells of large clams were collected from the stream banks and bottom by hand. These were identified by Dr. George Roemhild of the Montana State University Biology Department.

Egg Sampling

Walleye eggs were sampled using an egg basket described by Priegel (1970). The basket was placed on the streambottom and the gravel upstream of the basket was agitated with a garden rake. Current velocities were sufficient to wash eggs into the basket. In areas of no current velocity, the basket was swept through the cloud of debris raised from the streambottom by the garden rake. Walleye eggs were identified by size and by location of walleye spawners captured by electrofishing. The possibility of mistaking eggs of another species for walleye is very low because only the northern pike spawns as early as the walleye, and northern pike eggs are much larger.

Fish Studies

Larval Fish Sampling

Drifting larval fish were sampled with nets set in riffles. Plankton nets of 1000 micron mesh with removable plankton buckets were used. The net opening was sewn on an 18" x 12" rectangular frame that held the net open to the current. The rectangular frame was attached to a metal framework that was driven into the streambottom.

Two or three nets were set at each station for a half-hour period. Field samples were preserved in 10 percent formalin to which a biological stain had been added to make larval fish more visible. Water depths and velocities were measured at the mouth of the nets so that numbers of larval fish caught could be related to flow rates through nets. Larval fish were identified using keys by Hogue, Wallus and Kay (1976).

Fish Sampling

In 1976 fish were sampled with seines of 1/4 inch square mesh. Two different seines were used. Sizes were 100 x 10 feet and 25 x 4 feet. These seines were also used for a few days in April 1977, but were abandoned after that because electrofishing proved more effective.

A boom shocker was constructed for use on the Poplar River. Assistance in construction was provided by Larry Peterman, Ecological Services Division, Montana Department of Fish and Game, Miles City.

The electrofishing apparatus was mounted on a 14-foot fiberglass boat. It consisted of a 3500 watt AC generator, a Coffelt model VVP-10 rectifying unit, an aluminum plate negative electrode mounted on the boat bottom and two spherical positive electrodes suspended from booms.

Fish Processing and Tagging

Fish were anesthetized with MS-222, measured to the nearest 0.1 inch (total length) and weighed to the nearest 0.01 pound. Fish captured in April were examined for spawning condition. Those eight inches and longer were tagged with a numbered Floy anchor tag (catalog number FD-68B) using a Floy tagging gun (catalog number FDM-68). Tags were placed just below the dorsal fin.

Aging From Scales

Scale samples were collected when fish were processed. Fish were aged from plastic scale impressions made at the Montana Department of Fish and Game laboratory on the Montana State University campus.

Fish Population Estimates

Population estimates were made using mark and recapture methods similar to those described by Vincent (1971). A computer program was used to make the required calculations. The basic technique involves capturing fish in a stream section and marking them in a manner recognizable during recapture runs. A lower caudal clip was used in this study. Several days later fish were again captured in the stream section noting whether or not each fish was marked.

The formula used by the computer is:

$$N = \frac{(M + 1)\quad (C + 1)}{(R + 1)} - 1 \quad \text{where,}$$

N = Population estimate
M = Number of fish marked
C = Number of fish in recapture sample
R = Number of marked fish in recapture sample (C)

For purposes of the estimate the population was divided into two or more length groups. Each group contained at least seven recaptured fish. The fish in each group were apportioned to the various age groups, according to the aging from scales.

FINDINGS

Stream Channel Measurements

Measurements of stream channel width and depth were made because these factors are expected to decrease without the high spring flows necessary to maintain the stream channel configuration. Also, with the shallow depths in the Poplar River (Table 1), walleye and northern pike are existing under marginal physical conditions. Deep water is required for fish security and especially for winter living space. Early in 1978 much of the Poplar River froze to the bottom. Ice depths in much of the river reached 4 feet. Most of the measured stream sections offer only small areas that exceed 4 feet in depth (Table 1).

Width and depth measurements were made for nine stream sections in June, July or August 1977 (Table 1). Measurements were repeated for one section on the Middle Fork (Ofstedal) to determine precision of the technique. Both sets of measurements gave very similar results (Table 1).

The Poplar River consists of considerably more pool than riffle. In the majority of the measured sections, riffles made up less than 10 percent of the stream length. Pools are often long. Lengths of 0.5 mile are not uncommon.

Table 1. Physical data for nine stream sections in the Poplar River drainage.

Section	Date	Stream Discharge[d]	Length (feet)	Mean Width (feet)	Mean Depth (feet)	% of Section: As Riffle[b]	% of Section: >/ 3' Deep	% of Section: >/ 4' Deep	% of Section: >/ 5' Deep
East Fork Poplar River									
Upper Slab[a]	7-11,12,13-77	1.9 - 2.6	6,015	56.1	1.74	1.6	7.7	1.5	0.3
Cromwell[a]	6-21;7-11-77	4.9 - 5.6	7,560	75.7	2.70	5.3	44.6	23.1	8.8
Lower[a]	6-15,16,20-77	5.6 - 7.3	10,010	43.8	1.81	7.9	23.0	7.4	0.6
Middle Fork Poplar River									
Border	7-28;8-3,4-77	0.42- 7.3	7,785	34.7	1.45	17.7	10.4	3.1	1.3
Hagfeldt[a]	7-26,27-77	1.5 - 3.2[e]	8,240	63.0	1.86	7.3	17.9	4.1	0.6
Ofstedal[c]	7-19,20-77	0.29- 0.33[e]	7,525	48.8	1.51	13.2	12.6	4.3	1.7
Ofstedal[c]	7-21,22-77	0.24- 0.27[e]	7,510	48.0	1.46	15.8	12.7	4.0	1.6
West Fork Poplar River									
Susag[a]	8-10,11-77	2.5[f]	8,950	44.3	1.20	20.0	4.2	0.5	0
Poplar River									
Lund[a]	7-13,15,18-77	3.5 - 5.4[g]	9,800	74.1	2.16	4.0	28.0	8.8	1.2
Paulsen[a]	8-4,5;10-19-77	3.6 -10[f]	10,990	60.7	1.55	7.2	10.1	3.5	2.0

a - Section is identical to one used for fish population estimates.
b - Arbitrarily defined as percentage of cross-sections with mean depth less than 0.5 feet and width of less than 25 feet.
c - Section measurements repeated to determine precision of technique.
d - From unpublished USGS data; numbers shown are flows over period measurements were made.
e - Data are for USGS gage near border; actual flows are somewhat larger.
f - Estimated.
g - Obtained by adding flows of East Fork and Middle Fork near border.

Water depths are recognized to be considerably greater in the lowest several miles of the river, but no measurements were made there, and that reach of the river makes up a very small proportion of the drainage.

Stream Temperature

Stream temperature measurements on the Poplar River are the result of a cooperative effort between the U. S. Geological Survey and the Montana Department of Fish and Game. The USGS maintains thermographs on the East Fork Poplar River near the Canadian border and near the Pittinger bridge on the lower East Fork. The Montana Department of Fish and Game maintains thermographs on the West Fork (Susag location) and the Middle Fork (Ofstedal location). East Fork temperature measurements were begun in June 1975; temperature measurements at the other two locations were begun in April 1976. Thermographs are operated only during the ice-free period from early April to the second week of November.

A brief summary of monthly maximum and minimum temperatures is shown in Table 2. Daily maximum and minimum temperatures are given in Appendices A through D. Maximum temperatures in 1976 were 79 F and 80 F for the West and Middle Forks, respectively. Both of these streams reached 83 F in 1977. Maximum temperature reached on the East Fork was 79 F in 1976 (USGS 1976). However, in 1975 a maximum temperature of 85 F was attained on the East Fork Poplar River (USGS 1975). Data for the East Fork in 1977 has yet to be published. These maximum temperatures are not sustained, and are reached for, at most, a few hours.

Table 2. Monthly extreme water temperatures recorded for two Poplar River stations in 1976 and 1977.

Station	Year	In-Out Dates	A	M	J	J	A	S	O	N
W.Fork-Susag	1976	4/6-11/12	59-37	69-45	77-54	79-60	76-52	71-47	61-32	40-32
	1977	4/6-11/ 9	65-40	73-47	78-54	83-58	78-54	74-46	51-33	44-34
Middle Fork-Ofstedal	1976	4/7-11/12	58-38	70-47	79-57	80-61	78-55	72-48	59-32	42-32
	1977	4/6-11/9	66-34	73-48	80-56	83-57	75-57	69-48	52-36	43-34

Maximum temperatures of approximately 80 F are not harmful to walleye or northern pike in the summer when these species are acclimated to temperatures approaching that value. 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. Any increase in duration of temperatures in excess of 80 F is undesirable because of possible fish stress and growth-rate depression.

Dissolved Oxygen

The existence of lowered dissolved oxygen levels during winter ice cover in the East Fork was discovered from USGS data (Table 3). The same condition also exists in the West Fork near the international boundary. Concern for the situation here is less, however, as the upper West Fork does not support game fish. Values for a fourth station (West Fork-Susag) are also shown in Table 3. At this station dissolved oxygen values remain relatively high throughout the year and are typical of values for most of the remainder of the drainage.

To obtain more detailed dissolved oxygen information, frequent measurements were made from December 1977 to March 1978 (Table 4). Groundwater seepage from the base of the dam in Canada contained less than half the saturation value for dissolved oxygen through much of the winter period. Values dropped only slightly through the 2 river miles between the dam and the border. Values fell to considerably lower levels at downstream points in late winter (Table 4). A colder than average winter caused much of the river to freeze to the bottom. Ice depths exceeded 4 feet in places by late winter. No open water was found by late winter in the East Fork, even in riffles. The heavy ice cover helped depress dissolved oxygen levels.

The low East Fork dissolved oxygen values were caused by groundwater seepage at the base of the dam which contained low dissolved oxygen and by decomposition of plant material in the East Fork. Biochemical oxygen demand (BOD) and respiration of plant material were not causative. Morning-evening oxygen samples showed that the East Fork did not have enough living plant material to use any significant amount of oxygen by respiration. Five-day BOD samples, incubated at the State Department of Health and Environmental Sciences, revealed BOD in the East Fork to be uniformly low.

Low dissolved oxygen in the East Fork Poplar River caused spotty, but heavy, kills of walleye. Forty-four dead walleye and six dead northern pike were found by walking approximately 2 miles of stream, downstream from the Pittinger bridge. Dead walleye were noted on the banks at other locations along the East Fork. Only one live walleye was found in electrofishing approximately 3 miles of the East Fork downstream of the Pittinger bridge in April 1978. Over 100 walleye were captured in the same section in April 1977. Numbers of walleye present in other portions of the East Fork in April 1978 were below numbers found in April 1977, but differences were not so large. Large numbers of white sucker and carp also died in all parts of the East Fork.

Table 3. Dissolved oxygen values (Mg/L) for four stations in the Poplar River drainage.[a]

Time Period	Number of Samples	Dissolved Oxygen Range	Dissolved Oxygen Mean	Percent of saturation Range	Percent of saturation Mean
		East Fork Poplar River - Border			
12/74- 3/75	2	4.4- 6.6	5.5	33-50	42
12/75- 3/76	5	0.9- 6.8	3.8	7-50	28
12/76- 3/77	4	4.4-12.8	7.7	33-97	58
4/75-11/75	8	5.6-12.0	9.2	43-136	95
4/76-11/76	7	6.8-12.8	8.5	60-101	86
4/77- 9/77	6	6.8-12.3	8.6	83-107	93
		East Fork Poplar River - Pittinger Bridge			
1/30/76	1	-	5.1	-	38
1/77- 3/77	3	5.2-11.8	8.3	39-90	63
7/76-11/76	5	7.4-10.6	9.0	67-100	92
4/77- 9/77	6	6.9-10.4	8.4	75-104	92
		West Fork Poplar River - Border			
12/76- 3/77	4	2.2- 6.2	4.3	16-46	32
7/76-11/76	5	6.4-10.6	7.9	55-90	80
4/77- 9/77	5	5.7-11.3	8.7	56-144	98
		West Fork Poplar River - Susag			
12/76- 3/77	4	7.2-11.8	9.5	54-90	72
7/76-11/76	5	7.0-12.2	9.7	90-106	97
4/77- 8/77	5	8.3-10.0	9.1	93-117	102

a Data are from the U.S. Geological Survey (1975 and 1976) and from later unpublished USGS data.

Table 4. Dissolved oxygen concentrations (ppm) at stations in the Poplar River drainage, December 1977 to March 1978.

Station	Date: 12-21	12-28	1-13	1-23	2-16	2-23	3-7, 8[d]	3-7, 8[e]
East Fork Poplar River								
Base of dam	5.9	10.3	6.3	9.9	5.8	4.8	3.2	4.3
Border	5.9	6.0	4.2	4.2	3.1	3.6	4.3	4.2
Upper slab	-	4.1	4.0	5.0	f	2.5	1.6	1.1
Middle	-	-	5.5	11.5	f	f	-	-
Cromwell	8.6[a]-8.6[b]	10.8	7.7-7.2	13.0[c]	14.9-10.2	9.5-9.3	2.9	1.9
Pittinger bridge	8.5 -8.0	9.3-8.6	5.7-6.2	10.8[c]	4.3	0.1	f	f
West Fork Poplar River								
Peerless	7.9- 8.4	8.2-6.4	4.7-4.2	2.4-4.7	0.7-0.3	3.2-3.0	0.2-0.4	0.5-0.3
Susag	12.0-10.4	10.5-10.6	9.9-9.2	7.5-7.6	f	f	-	-

a - Sample taken at top of water under ice.
b - Sample taken near streambottom.
c - Waterflow over ice.
d - Samples taken early morning; East Fork samples on March 7, West Fork samples on March 8.
e - Samples taken in evening; East Fork samples on March 7, West Fork samples on March 8.
f - No water found below ice or ice depth exceeded 4.5 feet.

Low dissolved oxygen values have previously been recorded for the East Fork Poplar River (Table 3), but these values were not as low as those recorded from December 1977 to March 1978. Very few, if any, winter measurements were made before closure of the East Fork dam, so determination of the effect of the dam on dissolved oxygen is difficult to determine. Clearly, increased winter flows would help prevent dissolved oxygen values from reaching such low levels as were recorded in winter 1977-78. No comparison of streamflows has been made between the winter of 1976-77 (when no fish kill occurred) and 1977-78. Measurements were made by the U. S. Geological Survey, but they have not yet been published, and streamflow measurements made under stream ice conditions are not highly accurate. In all probability streamflows were not greatly different between the two winters.

Winter dissolved oxygen measurements from the West Fork Poplar River-Peerless location (Table 4) were made to help explain the lack of game fish found in this area. In late winter, values were below 1 ppm. The dissolved oxygen values are sufficiently low to explain the lack of game fish populations if values reach similar or even slightly higher levels each winter.

Bottom Fauna

Samples were collected in late March, late June and early November 1977. Results are shown in Table 5. Separation from the debris and sorting to taxonomic groups of organisms collected in November samples has not been completed. Mr. Mike Fillinger of Helena, Montana is presently identifying organisms collected in the field samples. No results have been received as yet.

Immature insects of the orders Diptera, Ephemeroptera and Trichoptera made up the bulk of organisms in samples. Total numbers of organisms per square foot were quite high, but variable. The March average was 616 (range 5 to 6263); corresponding figures for June were 804 and 34-2247.

Valves of a large clam were collected by hand picking from banks and shallow bottom areas. This clam is widespread and abundant in the Poplar River drainage. Samples were collected from several locations, but only a single species *(Anodontus grandis)* was found.

Fish Studies

Game Fish Distribution

General distribution of fish in the Poplar River drainage has been presented by Needham (1976). Since that time, distribution of game fish has been found to be somewhat larger. Game fish are not present in the middle reaches of the West Fork (vicinity of Peerless sampling station), and probably not in the upper reaches near the

Table 5. Number and volume (milliliter in parentheses) of macroinvertebrates collected in 1 square foot streambottom (riffle) sample for stations in the Poplar River drainage.

Date	Ephemer-optera	Diptera	Trich-optera	Amphipoda	Annelida[a]	Mollusca[b]	Other[c]	Total
Poplar River-Crowley								
3/24/77	11(.2)	17(T)[d]	3(T)	0	0	0	0	31(.2)
3/24/77	0	39(.2)	7(T)	0	0	0	0	46(.2)
3/24/77	3(T)	23(T)	5(T)	0	0	0	0	31(T)
3/24/77	3(T)	25(.1)	6(T)	0	0	0	0	34(.1)
3/24/77	31(.4)	11(T)	3(T)	0	0	0	0	45(.4)
6/29/77	526(7.8)	40(.1)	714(3.2)	0	1(T)	0	0	1281(11.1)
6/29/77	290(2.0)	16(T)	556(2.6)	0	0	0	0	862(4.6)
6/29/77	290(4.6)	0	108(.8)	0	0	0	0	398(5.4)
6/29/77	317(3.0)	18(T)	511(1.7)	0	0	1(.1)	0	847(4.8)
6/29/77	370(3.2)	9(T)	370(1.6)	0	0	0	0	749(4.8)
Poplar River-Paulsen								
3/24/77	9(.3)	426(1.0)	1(T)	1(T)	0	0	0	437(1.3)
3/24/77	22(.3)	425(1.3)	4(T)	1(T)	0	0	30(T)	482(1.6)
3/24/77	24(.4)	100(.4)	6(T)	0	0	0	0	130(.8)
3/24/77	52(.8)	193(.3)	9(T)	0	0	0	8(T)	262(1.1)
3/24/77	10(.2)	322(1.0)	1(T)	2(T)	0	0	5(T)	335(1.2)
6/29/77	417(4.6)	19(T)	1545(8.6)	0	0	0	0	1981(13.2)
6/29/77	231(.8)	8(T)	1005(4.1)	0	0	0	0	1244(4.9)
6/29/77	229(1.0)	0	1021(5.8)	0	0	0	0	1250(6.8)
6/29/77	264(1.0)	4(T)	1064(6.8)	1(T)	0	0	0	1333(7.8)
6/29/77	348(1.4)	10(T)	1187(6.6)	0	0	0	0	1545(8.0)
Poplar River-Lund								
3/23/77	9(T)	1019(2.15)	1499(10.5)	9(T)	1(T)	1(T)	1(T)	2539(12.65)
3/23/77	0	330(1.3)	294(4.1)	0	0	0	0	624(5.4)
3/23/77	20(T)	1114(1.9)	5118(29.1)	8(T)	0	3(T)	0	6263(31.0)
3/23/77	5(T)	849(1.7)	48(.2)	3(T)	0	1(T)	0	906(1.9)
3/23/77	11(T)	1138(1.9)	1493(8.8)	2(T)	0	1(T)	0	2645(10.7)
6/30/77	115(.1)	83(.1)	1043(6.8)	0	0	0	0	1241(7.0)
6/30/77	77(.1)	157(.4)	744(4.0)	0	65(.1)	4(2.0)	0	1047(6.6)
6/30/77	54(.1)	107(.5)	641(5.8)	0	44(.1)	0	0	846(6.5)
6/30/77	32(.2)	72(.6)	428(4.0)	0	11(T)	0	0	543(4.8)
6/30/77	41(.1)	40(.1)	1104(9.0)	0	9(T)	1(T)	0	1195(9.2)

Table 5 continued. Number and volume (milliliter in parentheses) of macroinvertebrates collected in 1 square foot streambottom (riffle) sample for stations in the Poplar River drainage.

Date	Ephemer-optera	Diptera	Trich-optera	Amphipoda	Annelida[a]	Mollusca[b]	Other[c]	Total
East Fork Poplar River-Pittinger Bridge								
3/22/77	3(T)	135(.3)	2(T)	9(T)	0	0	1(T)	150(.3)
3/22/77	3(T)	400(.7)	10(T)	9(T)	0	0	1(T)	573(.7)
3/22/77	2(T)	302(.2)	19(.1)	30(.7)	6(.4)	0	0	359(1.4)
3/22/77	1(T)	86(.1)	8(T)	6(T)	6(.9)	0	0	107(1.0)
3/22/77	3(T)	150(.1)	17(T)	24(T)	0	0	0	301(.1)
6/29/77	25(T)	31(T)	76(.8)	5(T)	5(.2)	0	0	142(1.0)
6/29/77	10(T)	22(T)	237(1.8)	0	0	0	0	269(1.8)
6/29/77	21(.2)	14(T)	28(.4)	0	1(.2)	0	0	64(.8)
6/29/77	24(.2)	40(.1)	608(5.6)	1(T)	5(.2)	0	0	678(6.1)
6/29/77	0	14(.1)	18(.2)	2(T)	0	0	0	34(.3)
East Fork Poplar River-Border								
3/22/77	0	595(1.1)	22(.2)	3(T)	1(.2)	18(.2)	8(18.0)	647(19.7)
3/22/77	2(T)	1129(2.7)	105(1.2)	8(T)	27(T)	0	0	1271(3.9)
3/22/77	7(T)	332(.8)	215(1.6)	8(T)	3(T)	0	3(7.0)	568(9.4)
3/22/77	1(T)	283(.5)	134(1.6)	4(.2)	22(T)	0	1(2.0)	445(4.3)
3/22/77	4(T)	378(.8)	353(4.4)	8(.2)	1(T)	0	2(3.0)	746(8.4)
6/29/77	2(T)	109(.4)	336(3.8)	38(.2)	18(T)	0	0	503(4.4)
6/29/77	2(T)	63(.6)	58(.5)	61(.4)	7(T)	0	2(5.8)	193(7.3)
6/29/77	1(T)	180(.8)	99(1.0)	393(2.4)	4(T)	5(.2)	4(.1)	686(4.5)
6/29/77	3(T)	86(.4)	220(3.2)	51(.4)	25(.2)	1(T)	0	386(4.2)
6/29/77	3(T)	55(.1)	133(1.4)	11(.1)	31(.2)	1(.1)	0	234(1.9)
Middle Fork Poplar River-Ofstedal								
3/22/77	4(T)	188(.3)	6(T)	0	0	0	0	198(.3)
3/22/77	3(T)	164(.2)	14(.1)	0	0	0	0	181(.3)
3/22/77	12(T)	115(.4)	529(3.0)	1(T)	0	0	0	657(3.4)
3/22/77	23(T)	211(.3)	1488(10.2)	12(T)	0	0	0	1734(10.5)
3/22/77	2(T)	86(.1)	35(.2)	1(T)	0	0	0	124(.3)
6/30/77	256(.4)	67(.2)	273(1.6)	1(T)	8(.2)	0	0	605(2.4)
6/30/77	300(.4)	100(.3)	363(2.2)	0	6(T)	0	0	769(2.9)
6/30/77	243(.2)	265(.4)	1529(7.8)	36(.2)	3(T)	0	0	2076(8.6)
6/30/77	245(.4)	75(.2)	157(.6)	0	6(T)	0	0	483(1.2)
6/30/77	47(.2)	67(.3)	357(3.6)	0	0	0	0	471(4.1)

Table 5 continued. Number and volume (milliliter in parentheses) of macroinvertebrates collected in 1 square foot streambottom (riffle) sample for stations in the Poplar River drainage.

Date	Ephemer-optera	Diptera	Trich-optera	Amphipoda	Annelida[a]	Mollusca[b]	Other[c]	Total
Middle Fork Poplar River at USGS station near Border								
3/22/77	4(T)	118(.2)	1(T)	8(.8)	0	0	0	131(1.0)
3/22/77	0	147(.2)	0	6(.2)	0	0	0	153(.4)
3/22/77	1(T)	59(.4)	13(T)	0	0	0	0	73(.4)
3/22/77	2(T)	1(T)	0	2(T)	0	0	0	5(T)
3/22/77	3(T)	15(T)	0	13(.1)	0	0	0	31(.1)
6/30/77[e]	307(2.6)	180(.6)	324(2.5)	247(2.8)	18(1.2)	8(.1)	7(.3)	1091(10.1)
West Fork Poplar River-Susag								
3/23/77	4(T)	12(.15)	20(.4)	0	0	0	0	36(.4)
3/23/77	8(T)	14(.4)	60(.8)	0	0	0	0	82(1.2)
3/23/77	89(.6)	35(.3)	346(3.6)	3(T)	3(.6)	0	0	476(5.1)
3/23/77	2(T)	23(.1)	9(T)	0	0	0	0	34(.1)
3/23/77	13(T)	8(.1)	201(3.1)	0	0	0	0	222(3.2)
6/29/77	443(3.4)	52(.2)	15(T)	1(T)	22(.8)	0	0	533(4.4)
6/29/77	1960(16.2)	32(.1)	227(1.0)	0	28(1.2)	0	0	2247(18.5)
6/29/77	518(4.9)	36(.1)	218(1.2)	0	18(.4)	0	0	790(6.6)
6/29/77	531(5.4)	24(.1)	114(.4)	0	7(.1)	0	0	676(6.0)
6/29/77	665(7.8)	74(.2)	221(.8)	0	5(T)	0	0	965(8.8)
West Fork Poplar River-6 miles South of Peerless								
3/23/77	386(2.2)	361(1.2)	239(2.9)	25(3.0)	0	0	1(1.0)	1012(10.3)
3/23/77	69(.7)	268(.8)	44(.5)	4(.6)	0	0	0	385(2.6)
3/23/77	129(.9)	433(1.1)	113(1.0)	10(1.4)	2(.1)	0	0	687(4.5)
3/23/77	157(1.0)	368(.4)	351(5.7)	1(.2)	7(4.0)	0	0	884(11.3)
3/23/77	0	330(1.3)	294(4.1)	0	0	0	0	625(5.4)
6/30/77	261(1.4)	80(.3)	12(T)	0	12(.6)	0	0	365(2.3)
6/30/77	692(6.2)	32(.1)	58(.3)	3(.2)	4(T)	2(T)	0	791(6.8)
6/30/77	656(3.3)	35(.2)	4(T)	6(.2)	4(.3)	0	0	705(4.0)
6/30/77	288(1.6)	79(.2)	19(.1)	0	8(.1)	0	0	394(2.0)
6/30/77	586(3.2)	103(.3)	22(.2)	6(.2)	5(.1)	0	0	722(4.0)

a - Annelida consists of Hirudinea and Oligochaeta.
b - Mollusca consists of both Gastropoda and Pelecypoda.
c - Consists of Decapoda, Hemiptera, Neuroptera, Gordioidea.
d - Trace.
e - Qualitative sample. Flow insufficient for quantitative sampler.

Canadian border, although that area has not been sampled. Walleye and northern pike are present throughout the remainder of the U. S. portions of the drainage, although numbers are low in the upper East Fork.

Distribution of sauger and smallmouth bass is similar. Both are present only in the lower few miles of the West Fork and in the main river from a few miles upstream of the Paulsen location and downstream to the mouth.

The burbot (ling) is also present in the lower several miles of the Poplar River. This fish was not listed by Needham (1976). It was captured in spring 1978 and may be present only seasonally.

Fish Spawning

Electrofishing (and some seining) was done over the period April 4 to April 22, 1977 to capture walleye and northern pike spawners. Results of this sampling are shown in Table 6. Spawning periods were short. Ripe female walleye were found only over the period April 14-21. Ripe female northern pike were found from April 12 to April 22, the last day of sampling. Northern pike spawning may have continued for a short time after April 22 as ripe females were still found on April 21 and 22. This is especially true on the East Fork, where spawning seemed to be a few days later due to a later ice-out date and later warming of the water.

Northern pike and/or walleye spawning appeared to occur over the whole drainage sampled except the upper and middle portions of the West Fork, where these species are not present (Table 6). That portion of the river downstream from the Crowley sampling location was not investigated. Sampling efforts were spread rather thinly over a large area. Failure to capture ripe or spent females at some locations and dates was probably due to not sampling at the proper time.

Some spent females were probably not recorded in the field as being spent. Fish were recorded as being spent females only if the abdomen was flaccid and a few eggs could be stripped. Considerable numbers of large flaccid-bellied fish were captured from which no eggs could be stripped. Many of these were probably spent females. Had these been recorded as spent, the numbers of fish in the column labeled "ripe or spent females" (Table 6) would have been greater.

Walleye and northern pike spawners captured in April 1977 were aged from mounted scale samples. 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.

Table 6. Total number of walleye and northern pike captured and numbers of fish in spawning condition, April 1977.

Location	Date	Walleye			Northern Pike		
		Number Caught	Ripe Males	Ripe or Spent Females	Number Caught	Ripe Males	Ripe or Spent Females
Middle Fork Poplar River							
Border	4/14/77	12	8	0	2	0	1
Hagfeldt	4/14/77	55	28	1	5	2	2
Ofstedal	4/11/77	10	1	0	1	0	0
Ofstedal	4/19/77	46	28	2	3	2	1
Middle Fork Mouth	4/20/77	60	8	5	4	1	0
Totals		183	73	8	15	5	4
Main Poplar River							
Lund	4/04/77	0	0	0	3	0	0
Lund	4/15/77	92	34	1	8	3	3
Lund	4/22/77	80	51	0	11	4	5
Paulsen	4/07/77	4	0	0	35	0	0
Paulsen	4/13/77	11	4	0	24	13	3
Crowley	4/05/77	0	0	0	9	0	0
Crowley	4/13/77	3	2	0	8	4	2
Crowley	4/18/77	6	1	2	10	4	5
Totals		196	92	3	108	28	18
West Fork Poplar River							
Peerless	4/19/77	0	0	0	0	0	0
Lower	4/07/77	0	0	0	2	0	0
Lower	4/18/77	38	22	2	15	6	4
Totals		38	22	2	17	6	4

Table 6 continued. Total number of walleye and northern pike captured and numbers of fish in spawning condition, April 1977.

Location	Date	Walleye			Northern Pike		
		Number Caught	Ripe Males	Ripe or Spent Females	Number Caught	Ripe Males	Ripe or Spent Females
				East Fork Poplar River			
Upper Slab	4/15/77	1	0	0	24	10	0
Middle	4/21/77	4	2	0	10	5	4
Cromwell	4/12/77	29	8	0	7	4	2
Cromwell	4/21/77	57	36	5	8	2	3
Lower	4/12/77	68	22	0	3	1	1
Lower	4/20/77	37	6	0	0	0	0
Totals		196	74	5	52	22	10
Grand Totals		613	261	18	192	61	36

Walleye and northern pike spawners were again sampled by electrofishing in spring 1978. All locations sampled in 1977 were repeated in 1978. Fish were also sampled from the lower portion of the river between the mouth and the Crowley area. The data have not yet been analyzed and tabulated, but some preliminary observations can be made. Walleye and northern pike spawners were again present in almost all locations sampled. Concentrations of walleye were found in the pool tails just upstream of riffles and immediately downstream of riffles. Good numbers of walleye, sauger and northern pike spawners were captured in the lower river between the Crowley sampling location and the mouth.

Egg Sampling

Walleye eggs were found at all locations sampled with the egg basket in April 1978 following spawning. All habitat types were sampled. Measurements of water depth, velocity and substrate were made at points where walleye eggs were found to determine the physical requirements for walleye spawning in the Poplar River. Analysis of these data has not been made, but some preliminary observations can be given. Eggs were, almost without exception, found in water with velocities greater than 1 foot per second at 0.6 of the depth. Water depths were mostly less than 2 feet and the substrate was clean gravel. These locations were the downstream ends of pools and riffles.

Considerable effort was made to locate northern pike eggs by inspecting vegetation. No northern pike eggs were found despite the fact that considerable numbers of spawners were captured.

Larval Fish

Small mesh plankton nets for capture of larval fish were set in riffles at 12 stations over the period April 25, 1977 to June 2, 1977. The complete sampling schedule is shown in Table 7. Each station was sampled 13 to 17 times, and a total of 195 samples was collected. Nets were positioned in the fastest water on narrow portions of the river, so that the greatest possible fraction of the streamflow was sampled. Two or three nets were sufficient to sample over half of the streamflow on the East Fork Poplar River. A lesser fraction of the streamflow passed through nets at other stations because flows were larger.

Twenty larval walleye were captured at 5 of the 12 stations (Table 8). Despite a greater sampling efficiency on the East Fork because of lower streamflows, no larval walleye were captured at the three East Fork stations. They were caught at the one West Fork station sampled, one of four Middle Fork stations, and at three of the four stations on the main river. Some of the larval fish identified as walleye at the Crowley and Town of Poplar stations may have been sauger. Because of the similarity between the larvae of these two species, no attempt was made to distinguish between them.

Table 7. Larval fish sampling schedule and number of minutes two or three[c] nets were set at each station.

	East Fork			Middle Fork				Poplar River				West Fork
Date	Upper Slab	Cromwell	Mouth	Border	Hagfeldt	Ofstedal	Mouth	Lund	Paulsen	Crowley	Town of Poplar	Susag
4/25/77									34	34	22	
4/26/77			45		29	31	17	16				29
4/27/77	18	29		47					30	29	22	
4/28/77			33			25	34	39				19
5/ 2/77	17	25		24	18				31			
5/ 3/77	25	31+30	30				30		30	30	30	30
5/ 4/77	32			30	30	30		28	30			
5/ 5/77	28	49							30	28	32[a]	30
5/ 6/77			30	30	33[a]	30	30	45				
5/ 9/77	31	30							53	41	35	30[a]
5/10/77	30	30	41	30	30	30	30	50	30	30		30[a]
5/11/77			32				33		30[a]	29[a]	30[a]	31
5/12/77	32	45	30	30	30	30	33	30	24[a]	30[a]	34[a]	30
5/14/77			30	33	30	42	30	26				
5/16/77	23	30							33	30	27[a]	30[a]
5/17/77			30	31	31	30	33	30				
5/18/77	28	29	30	30	16	38	30	30	30	31	31	30
5/19/77	30	33[b]	30	30	20	30	30	30	28	28	31	30
5/20-21/77		1153[b]										
5/23/77	31	29					29		31	30	33	28
5/24/77			31	29	30	29		27				
5/25/77		33							31	31	30	32
5/26/77	31		31	34	30[a]	30	30	32				
5/27/77	22	52							30	26	30[a]	30[a]
6 /2/77	32	46	31	30	32	30		15	30	32	21[a]	34
Times sampled	15	16	14	13	13	13	13	13	17	15	14	15
Minutes sampled	410	1674	454	408	359	405	389	398	535	459	408	443

a - Samples with larval walleye
b - 24-hour sample
c - Three nets routinely used at all stations except East Fork where most of flow could be sampled with two nets.

Table 8. Summary of larval walleye captured at stations in the Poplar River drainage.

Station	Date	Number Captured	Total Length (mm)	Sample Time
		Middle Fork		
Hagfeldt	5/ 6/77	4	8, 8.5, 8.5, 9	2122-2155
Hagfeldt	5/26/77	1	20.5	1200-1230
		West Fork		
Susag	5/10/77	3	7, 10, 11	1715-1745
Susag	5/27/77	1	20.5	1119-1149
		Poplar River		
Paulsen	5/12/77	1[b]	10	0810-0844
Crowley	5/12/77	1[b]	10.5	0647-0717
Crowley	5/16/77	1[b]	13	0923-0953
Town of Poplar	5/ 5/77	1[b]	10	0604-0636
Town of Poplar	5/11/77	2[b]	12, 12	0805-0835
Town of Poplar	5/12/77	3[b]	11, 11, 14	0515-0549
Town of Poplar	5/16/77	1[b]	15	0759-0826
Town of Poplar	6/ 2/77	1	35[a]	0532-0553

a - Juvenile
b - May include sauger. No attempt was made to distinguish between walleye and sauger.

In spite of the low number of larval walleye captured, the larval sampling may be useful in predicting the size of year classes formed. Although it has not been calculated, the correlation between numbers of larval walleye captured and size of young-of-the-year populations formed by fall is probably quite high. No larval walleye were captured on the East Fork and fall young-of-the-year walleye populations were extremely low (fish population estimates are shown in a later section). At the Hagfeldt (Middle Fork), Susag and Paulsen (main river) locations, where larval walleye were captured, fall estimates for walleye young-of-the-year were relatively high.

Lack of natural spring runoff in the East Fork is the probable reason for the paucity of larval walleye present. In 1977 the East Fork dam impounded the spring runoff for the first time. However, the remainder of the drainage also experienced a low runoff in 1977.

Current velocities were measured at the mouth of larval sampling nets, but insufficient numbers of larval walleye were captured to make comparisons between stations on the basis of numbers of larval walleye per volumes of water sampled.

Other species of larval fish were captured, but northern pike were not found in larval samples. A total of 3675 larval fish was captured in the 195 samples. Included were 2471 unidentified Catostomids (probably white suckers), 177 Cyprinids, and 999 Iowa darters. Walleye were first captured on May 5, 1977, Catostomids on May 9, Cyprinids on May 12 and Iowa darter on May 16.

A 24-hour sample was collected on May 20 and 21, 1977 at the Cromwell, East Fork station. Buckets on nets were emptied each hour to determine hours of lesser and greater vulnerability of larval walleye to capture by nets throughout the 24-hour period. This experiment failed, however, as no larval walleye were captured.

Larval fish were again sampled in spring 1978. The Poplar River drainage experienced a normal spring runoff, with the exception of the East Fork. This should give a good opportunity to assess the effect of streamflows on spawning success. Larval sampling for 1978 is nearly completed, but identification of larval fish in samples will not begin until late fall. A tow net is also being used to sample larval fish with the hope that this method will considerably increase the sample size of walleye.

Fish Population Estimates

Estimates of numbers of game fish present in stream sections were made in 1977 to document the condition of Poplar River fish populations before development proceeded further. One estimate was made on the East Fork Poplar River in September 1976. This estimate was made largely to measure the size of the young-of-the-year walleye population, but older fish were measured, too. Data for both years are given in Table 9. Two population estimates were also made by Needham (1976) in 1975. The locations used by Needham (1976) were given different names, but are the same as the East Fork-Lower and main river-Lund sections of this report. He included only age I+ and older walleye in estimates and calculated 178 and 297 walleye per mile for the East Fork and main river sections, respectively. These numbers are more than twice the values found in 1977 (Table 9), suggesting that East Fork and upper Poplar River populations have decreased.

In 1977 number of walleye per river mile varied from 276 (over half age 0+) at the Middle Fork section to 23 at the East Fork-Upper Slab section (Table 9). Numbers of northern pike were highest at the Cromwell section on the East Fork (197 per mile) and lowest at the East Fork-Upper Slab section where only a single northern pike was captured.

Table 9. Walleye and northern pike population data for stream sections in the Poplar River drainage.

Age Class	Mean Length (inches)	Mean Weight (pounds)	Estimated Number	Estimated Weight (pounds)	Fish Marked	Fish in Recapture Sample	Marked Fish in Recapture Sample	Number per Mile	Weight per Mile (pounds)
East Fork Poplar River - Upper Slab Section, 6,015 ft - Walleye - Sept. 1977									
0+	6.2	0.08	12	0.9					
I+	13.1	0.79	11	8.5					
II+	15.3	1.21	3	3.2					
Totals			26 (±4) [a]	12.6 (±2)	20	18	14	22.8	11.4
East Fork Poplar River - Cromwell Section, 7,560 ft - Aug. 1977									
Walleye									
0+	4.5	0.03	b	b	3	2	0		
I+	8.5	0.17	8	1.4					
II+	11.7	0.47	143	66.5					
III+ & Older	16.2	1.38	79	108.4					
Totals			230 (±29)	176.2 (±18)	117	129	66	160.1	123.1
Northern Pike									
0+	None captured								
I+	18.4	1.35	106	143.5					
II+	22.4	2.62	73	190.2					
III+ & Older	26.8	5.15	102	526.3					
Totals			281 (±84)	860.0 (±227)	50	85	15	197.2	601.4
East Fork Poplar River - Lower Section, 10,010 ft - Oct. 1977									
Walleye									
0+	5.6	0.05	b	b	5	1	0		
I+	8.6	0.19	42	7.8					
II+	10.9	0.39	49	19.1					
III+ & Older	16.4	1.43	73	104.8					
Totals			164 (±22)	131.7 (±13)	96	106	62	86.8	69.5

Table 9 continued. Walleye and northern pike population data for stream sections in the Poplar River drainage.

Age Class	Mean Length (inches)	Mean Weight (pounds)	Estimated Number	Estimated Weight (pounds)	Fish Marked	Fish in Recapture Sample	Marked Fish in Recapture Sample	Number per Mile	Weight per Mile (pounds)
				Northern Pike					
0+	12.3	0.43	1	0.5					
I+	20.2	1.99	15	28.9					
II+ & Older	23.2	3.33	10	33.1					
Totals			26 (±4)	62.5 (±10)	20	18	14	13.7	33.2
East Fork Poplar River - Pittinger Bridge Section, 2,640 ft - Walleye - Sept. 1976									
0+	5.0	0.04	159	5.8					
I+	9.6	0.26	128	33.0					
II+ & Older	13.3	0.83	35	28.7					
Totals			322 (±61)	67.5 (±16)	118	71	25	644	135
Middle Fork Poplar River - Hagfeldt Section, 8,240 ft - Walleye - Sept. 1977									
0+	4.7	0.03	291	9.6					
I+	8.0	0.15	34	5.2					
II+	9.8	0.28	82	23.0					
III+ & Older	17.4	1.77	23	40.0					
Totals			430 (±82)	77.8 (±6)	194	191	119	276.3	49.4
Poplar River - Lund Section, 9,800 ft - Sept. 1977									
				Walleye					
0+	5.2	0.04	69	2.7					
I+	7.8	0.14	59	8.2					
II+	9.9	0.29	45	13.0					
III+ & Older	14.8	1.17	43	49.8					
Totals			216 (±32)	73.7 (±6)	108	119	69	116.7	39.8

Table 9 continued. Walleye and northern pike population data for stream sections in the Poplar River drainage.

Age Class	Mean Length (inches)	Mean Weight (pounds)	Estimated Number	Estimated Weight (pounds)	Fish Marked	Fish in Recapture Sample	Marked Fish in Recapture Sample	Number per Mile	Weight per Mile (pounds)
				Northern Pike					
0+	9.2	0.18	b	b	4	1	0		
I+	18.4	1.38	31	43.2					
II+	23.0	2.83	54	152.0					
III+ & Older	27.9	5.75	32	185.8					
Totals			117(±15)	381.0(±44)	73	97	60	62.9	204.8
Poplar River - Paulsen Section, 10,990 ft - Oct. 1977									
				Walleye					
0+	5.6	0.05	159	7.5					
I+	9.2	0.22	53	11.6					
II+	10.8	0.38	24	9.2					
III+ & Older	14.4	1.06	27	28.5					
Totals			263(±53)	56.8(±4)	112	141	86	126.9	26.9
				Northern Pike					
0+	10.0	0.21	b	b	19	17	5		
I+	15.8	0.78	47	36.7					
II+	18.8	1.40	61	85.4					
III+ & Older	24.0	3.67	39	141.7					
Totals			147(±18)	263.8(±37)	75	106	54	70.7	126.9
West Fork Poplar River - Susag Section, 8,950 ft - Walleye - Nov. 1977									
0+	5.5	0.05	104	4.9					
I+	8.8	0.20	56	10.9					
II+	11.8	0.46	24	11.3					
III+ & Older	17.1	1.74	69	120.8					
Totals			253(±25)	147.9(±24)	146	181	113	149.0	87.3

a - 80 percent confidence interval.
b - Marked fish in recapture sample insufficient for estimate.

Estimates are not shown in Table 9 for northern pike for three of the sections done in 1977 because numbers of marked fish recaptured were insufficient to satisfy statistical criteria. Approximate estimates of northern pike for the Hagfeldt and Susag sections are 24 and 6, respectively.

Reproduction of northern pike in 1977 appeared to be low, especially for the East Fork, where reproduction failed entirely. Only one age 0+ northern pike was captured in the East Fork in the lower section. None were found in the other two sections. Numbers in the remainder of the drainage were low compared to adult populations (Table 9). Reproduction seemed fair only in the Paulsen section where an approximate estimate of 28 per mile age 0+ northern pike was calculated. No age 0+ northern pike were captured in the Susag section, 6 in the Hagfeldt section, and 5 in the Lund section. As would be expected, northern pike reproduction seemed correlated with spring runoff, with reproduction failing entirely where a runoff was absent in the East Fork and low in the remainder of the drainage where runoff was low.

Success of the 1977 year class of walleye paralleled that of the northern pike. The 1977 year class of walleye in the East Fork all but completely failed (Table 9). This is in sharp contrast to the Pittinger bridge section of the East Fork in 1976 (Table 9), where a large year class was formed in a year of average spring runoff. Numbers in the remainder of the drainage in 1977 were mostly adequate to maintain existing populations (Table 9).

Growth rates of walleye and northern pike in the Poplar River drainage are not greatly different from state averages given by Brown (1971), with the exception of the few walleye present in the upper East Fork (Table 9). These grew much faster than the state average. In general, Poplar River walleye grew somewhat more rapidly than the state average for the first 2 years and then more slowly. Northern pike grew at a rate close to the state average given by Brown (1971) for the first 2 years and then somewhat more rapidly.

Large numbers of smallmouth bass were found only in the Paulsen section. Although numbers of recaptured fish were insufficient for calculation of statistically valid estimates, approximate estimates are 143 age 0+ and 8 age I+ and older smallmouth bass in the Paulsen section.

Fish Movement and Migration

Northern pike and walleye in the Poplar River seem to be quite sedentary. Most fish probably spawn within their home ranges. Table 10 is a summary of fish tagged in April 1977, tag return by anglers and recapture of tagged fish by electrofishing. Of 563 walleye and 183 northern pike tagged in April 1977, 47 (8.3 percent) walleye and 31 (16.9 percent) northern pike were recaptured by anglers and electrofishing combined. The majority of the tag returns were by electrofishing (Table 10).

Of nine angler returns of tags placed on walleye in April 1977, all were caught near where marked. Of three northern pike, one had moved. This fish was marked in the Lund section and had moved about 8 miles downstream. Of these tag returns, most were caught within one month of tagging.

Fish tagged in April 1977 were recaptured while making population estimates during August, September and October. Of 38 walleye and 28 northern pike recaptured, 2 walleye and 1 northern pike had moved. The distances moved were 4, 5 and 9 miles, both up and downstream.

Fish were also tagged in 1975. Many of these were recaptured during 1977 electrofishing, but the numbered plastic sleeves had been lost from most tags. Only four fish were recaptured with the numbered sleeve intact. All were walleye recaptured at the same location where tagged. These fish were tagged from May to September 1975. Three of them were recaptured during the April spawning season and all were of spawning size.

Tags from 14 fish tagged in August and September 1975 were returned by anglers. Only two moved from the tagging location. A walleye tagged at the Crowley area was caught approximately 15 miles downstream. A northern pike tagged 4 miles north of the town of Poplar was caught 10 miles north of the town of Poplar.

In conclusion, the majority of walleye and northern pike are probably quite sedentary. A mass migration of spawners to a few areas was not found. Most northern pike and walleye probably utilize spawning habitat within home ranges.

The upper East Fork is an exception. There was a spawning run of northern pike into this area in April 1977. During April 1977 northern pike were present near the Upper Slab station (Table 6). Only a single northern pike was captured at this station during 3-1/2 days of electrofishing in September 1977.

Several hundred walleye, northern pike and sauger spawners were again tagged in spring 1978. Fish from the lower few miles

Table 10. Recapture by angling and electrofishing of fish tagged April 1977.[a]

Number Tagged		Returned by Anglers				Recaptured by Electrofishing				Total			
		Walleye		N. Pike		Walleye		N. Pike		Walleye		N. Pike	
Walleye	N. Pike	No.	%[b]	No.	%	No.	%	No.	%	No.	%	No.	%
Tagged in Middle Fork Poplar River													
160	15	1	0.6	1	6.7	1	0.6	1	6.7	2	1.2	2	13.3
Tagged in Main River													
187	101	6	3.2	2	2.0	8	4.3	21	20.8	14	7.5	23	22.8
Tagged in West Fork Poplar River													
31	16	0	0	0	0	0	0	0	0	0	0	0	0
Tagged in East Fork Poplar River													
185	51	2	1.1	0	0	29	15.7	6	11.8	31	16.8	6	11.8
563	183	9	1.6	3	1.6	38	6.7	28	15.3	47	8.3	31	16.9

a Angler tag return was over the period April 1977 to September 1977; recapture by electrofishing was from August 1977 to November 1977.

b Percentages are of the total number of walleye or northern pike tagged in April 1977.

of the Poplar River were included. Fish tagged in 1977 were recaptured and angler tag returns have been received in April and May 1977. These data have not yet been analyzed and tabulated. They will be given in a future report.

RECOMMENDATIONS AND ADDITIONAL STUDIES NEEDED

The following relate to the Poplar River:

1. Stream channel width and depth should be measured at one additional section in the lower river where this has not yet been done.

2. Thermographs should continue to be maintained on all three of the forks to determine natural stream temperature and to measure any changes on the East Fork.

3. Winter dissolved oxygen should be measured again on the East Fork during winter 1978-79. Summer dissolved oxygen measurements should also be made on all three forks at sunrise to determine how close summer minima are to critical values.

4. Power plant operation on the East Fork will deposit metals in the drainage. Fish from all three forks should be collected for metals analysis prior to power plant start-up. Arrangements have been made with the EPA laboratory in Denver for analysis.

5. The upstream limit of game fish in the West Fork and its tributary, Cottonwood Creek, should be determined.

6. More fish should be tagged in the lower several miles of the Poplar River in April 1979. Limited work done here in 1978 suggests a major run of sauger out of the Missouri River.

7. Population estimates made in 1977 should be repeated in 1978 to monitor effects of development on fish populations. Special efforts should be made to estimate age 0+ game fish.

8. Population estimates should be made at two new locations. These locations are the lower river and the Middle Fork near the Canadian border.

9. Instream flows should be formulated for the Poplar River drainage.

10. Additional amounts of water are needed in the East Fork. Without this, populations of walleye and northern pike will probably be decreased below the point of supplying a significant sport fishery.

11. Some way should be developed to increase the dissolved oxygen of water seeping from the base of the East Fork dam. Future winter fish kills are likely unless this is done.

Scope of the project should be expanded to include fish population investigations on Big Muddy Creek and the Missouri River between Fort Peck dam and the North Dakota border. Portions of Big Muddy Creek are presently under study by the International Joint Commission for apportionment between Canada and the U. S., and very little is known about fish populations in the drainage. The state of information on the lower Missouri River is similar. Various developments and water demands are expected in the lower Missouri River. Basic understanding of fish populations will be a major effort, but a start should be made soon.

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August 1978

Appendix A. Daily maximum and minimum water temperatures for the Ofstedal location on the Middle Fork Poplar River 1976.

Day	April	May	June	July	Aug.	Sept.	Oct.	Nov.
1		49-57	62-75	62-71	64-73	62-67	52-59	38-42
2		47-57	66-78	65-68	64-75	60-64	54-59	35-38
3		48-57	65-75	64-72	67-74	57-65	50-57	32-36
4		51-61	64-72	65-75	66-67	59-66	38-50	33-38
5		51-61	65-69	69-75	64-68	60-67	34-43	35-39
6		51-61	63-70	66-72	63-74	62-66	41-47	36-39
7	-53	51-61	64-71	70-74	66-73	57-63	40-47	33-36
8	49-55	55-64	64-73	71-75	65-76	52-57	43-52	34-39
9	51-57	57-65	68-76	73-76	66-73	50-61	46-54	33-37
10	51-55	57-68	69-79	73-76	65-70	52-64	47-54	32-34
11	47-52	55-58	69-76	73-76	65-73	54-63	48-54	32-34
12	49-56	49-56	64-72	70-74	67-76	57-61	48-52	32-
13	50-58	53-63	60-65	67-72	70-78	55-65	44-50	
14	51-57	55-60	62-63	68-73	68-76	54-63	38-48	
15	51-57	56-61	59-65	65-72	65-73	58-66	30-39	
16	47-53	53-65	62-64	64-75	66-74	58-72	35-40	
17	39-47	55-62	58-64	67-77	65-75	60-69	34-37	
18	38-44	56-65	60-68	72-79	65-72	56-69	36-40	
19	40-46	56-67	62-70	72-77	66-70	51-61	35-40	
20	42-50	58-65	65-72	70-78	65-69	52-60	34-38	
21	45-50	57-70	65-74	68-76	61-70	54-63	32-37	
22	45-50	61-69	63-68	68-76	64-71	55-60	34-37	
23	45-48	59-66	61-64	67-80	63-72	50-62	33-35	
24	44-49	57-63	58-64	68-79	65-72	51-58	33-34	
25	45-53	56-63	58-62	69-76	62-72	54-60	32-33	
26	46-51	53-61	58-61	68-76	64-72	53-57	32-33	
27	46-50	53-68	57-60	66-72	55-64	48-53	33-37	
28	46-51	58-69	58-63	61-74	55-60	48-55	35-41	
29	48-53	60-67	59-67	65-73	57-69	51-57	36-40	
30	47-55	59-69	62-70	64-69	61-67	54-59	39-43	
31		62-70		64-75	61-67		38-42	

Appendix B. Daily maximum and minimum water temperatures for the Susag location on the West Fork Poplar River 1976.

Day	April	May	June	July	Aug.	Sept.	Oct.	Nov.
1		48-56	61-73	63-71	65-68	60-69	51-61	38-40
2		45-56	64-77	63-67	64-73	59-66	53-61	35-39
3		47-57	64-73	60-69	66-75	55-66	49-59	33-37
4		50-59	63-73	63-74	62-67	57-67	39-49	34-37
5		49-58	61-66	67-75	63-68	59-69	35-44	35-38
6	-53	49-59	61-68	68-79	62-73	61-67	41-48	35-38
7	46-54	49-61	-	70-75	66-74	57-62	39-44	33-37
8	47-56	54-65	-73	69-78	64-76	51-57	42-49	34-37
9	49-58	56-65	66-73	71-78	64-70	49-61	45-51	32-37
10	48-54	56-66	68-77	70-77	62-69	52-63	47-51	32-34
11	43-53	52-59	68-75	69-76	63-71	54-64	48-51	32-34
12	47-54	48-57	58-69	66-73	65-77	58-62	47-50	32-
13	49-59	51-62	57-66	65-73	68-76	53-63	43-48	
14	48-54	53-59	58-64	65-73	66-74	54-63	39-48	
15	48-58	51-59	56-66	62-71	63-72	58-66	36-39	
16	43-53	52-63	59-63	62-76	65-73	58-70	36-39	
17	38-43	54-63	56-66	67-79	64-74	60-71	33-37	
18	37-46	56-65	57-70	71-78	65-73	56-68	35-39	
19	41-46	56-	60-72	71-78	65-72	51-61	35-38	
20	40-50	59-62	64-72	69-77	64-70	51-60	34-37	
21	44-50	56-68	64-73	68-77	60-70	52-64	33-36	
22	44-50	60-69	61-67	67-75	63-72	54-60	35-37	
23	42-47	60-66	59-62	66-78	62-75	49-59	33-36	
24	41-48	56-63	57-62	69-77	64-68	51-60	34-35	
25	44-52	56-64	57-61	68-75	62-	54-61	33-34	
26	44-50	52-58	54-61	67-76	-66	53-57	32-33	
27	43-49	52-66	57-61	65-76	53-60	47-55	32-37	
28	44-49	58-68	58-65	60-72	52-62	48-58	34-40	
29	44-51	59-63	59-69	63-72	58-72	50-59	35-40	
30	44-55	57-67	62-72	64-71	62-70	53-60	37-41	
31		61-69		65-74	61-71		36-40	

Appendix C. Daily maximum and minimum water temperatures for the Ofstedal location on the Middle Fork Poplar River 1977.

Day	April	May	June	July	Aug.	Sept.	Oct.	Nov.
1		52-64	63-72	61-71	67-72	58-60	47-50	40-42
2		53-58	63-70	62-71	67-72	57-60	46-52	40-43
3		52-63	-	62-73	66-68	58-64	47-50	38-40
4		53-58	-72	66-78	63-68	59-63	45-48	38-39
5		49-56	-72	66-77	62-70	62-66	43-47	37-39
6	35-40	48-59	63-75	60-75	65-70	63-66	43-45	37-41
7	34-44	52-62	66-76	57-66	65-69	63-69	43-44	37-39
8	38-49	56-68	66-	57-68	65-75	58-66	43-47	35-37
9	44-54	61-72	-	59-73	63-70	56-61	43-46	34-36
10	47-50	63-73	-	61-74	60-66	56-64	37-43	
11	44-53	63-70	-	61-67	60-67	59-66	36-41	
12	45-54	61-70	-	63-70	62-64	59-62	38-46	
13	46-56	61-73	-58	60-68	59-66	57-65	43-46	
14	48-57	63-72	56-63	60-78	60-65	58-65	43-47	
15	49-58	64-71	60-67	65-74	61-67	58-62	42-47	
16	50-61	56-68	60-64	67-80	61-65	55-58	43-48	
17	50-56	56-61	-68	69-79	59-69	55-56	43-47	
18	48-56	54-57	-73	70-83	62-75	54-56	43-48	
19	47-53	53-55	64-74	67-74	66-73	53-59	44-49	
20	46-49	51-59	64-71	63-77	67-69	55-58	46-47	
21	43-50	53-65	-	66-75	64-66	54-57	43-46	
22	45-55	58-68	-74	67-79	63-65	54-58	44-48	
23	47-58	61-69	-76	70-77	61-63	56-57	44-49	
24	49-61	61-72	-80	67-77	60-67	55-56	45-48	
25	53-63	65-70	-77	66-71	64-69	54-57	46-49	
26	55-66	65-72	-77	65-74	63-65	55-57	47-49	
27	51-62	65-72	-	67-76	62-64	53-57	43-46	
28	54-63	61-68	-	70-82	59-62	53-56	44-48	
29	54-65	59-64	-	72-81	61-64	50-53	45-47	
30	55-63	61-66	60-66	64-69	57-61	48-50	45-46	
31		61-70		61-72	58-61		42-43	

Appendix D. Daily maximum and minimum water temperatures for the Susag location on the West Fork Poplar River 1977.

Day	April	May	June	July	Aug.	Sept.	Oct.	Nov.
1		52-63	62-71	59-74	64-73	57-62	45-48	39-43
2		53-58	61-68	63-70	64-72	56-62	44-51	40-44
3		53-69	60-67	61-72	63-68	58-66	46-51	38-41
4		54-61	61-72	65-73	62-68	59-65	44-47	37-40
5		47-55	62-70	66-76	58-72	62-69	40-45	36-40
6	-46	48-59	63-73	68-71	65-71	61-64	41-44	38-41
7	40-50	51-61	65-74	64-69	64-75	60-74	42-43	38-41
8	44-50	56-69	62-65	62-75	64-78	57-68	42-47	35-39
9	48-56	62-73	60-69	64-75	62-67	52-62	40-45	34-36
10	48-51	64-72	62-67	68-75	58-68	56-66	35-40	
11	44-54	62-69	58-64	64-69	59-71	58-66	33-39	
12	47-55	60-70	56-61	65-73	62-66	60-65	36-45	
13	46-56	59-71	54-58	67-72	58-69	56-66	43-47	
14	47-57	60-70	55-62	62-79	59-68	57-67	43-47	
15	49-58	62-72	60-67	67-77	60-70	57-63	41-47	
16	51-61	55-63	60-66	67-81	59-70	55-57	43-49	
17	50-55	54-58	60-64	70-79	58-74	54-55	42-46	
18	47-54	53-55	59-71	71-82	60-76	53-58	42-47	
19	48-53	52-56	64-72	67-70	65-75	53-60	43-50	
20	44-47	52-60	64-69	63-76	64-69	54-60	47-49	
21	42-49	54-64	62-66	66-74	62-67	55-59	44-47	
22	45-55	58-65	63-73	68-83	61-63	54-62	44-49	
23	47-59	59-68	65-75	72-78	58-63	56-59	44-50	
24	50-61	61-73	67-78	68-78	57-69	54-56	46-50	
25	52-62	63-69	69-75	67-70	63-71	52-56	47-51	
26	55-65	61-68	65-75	66-75	61-65	52-56	48-50	
27	55-61	62-67	65-71	68-79	60-63	50-57	43-48	
28	53-62	59-65	63-73	68-81	56-67	51-54	44-48	
29	55-65	57-64	63-69	69-79	59-63	48-51	44-48	
30	57-64	57-66	57-66	62-69	54-62	46-48	46-48	
31		58-69		58-71	57-62		42-46	

List of Waters Referred to:

Poplar River	16-2820-02
West Fork	16-4060-02
Middle Fork	16-2375-02
East Fork	16-1415-02