POPLAR RIVER FISHERIES STUDY
PROGRESS REPORT

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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.

Much of the results of field work are not yet available. Complete results will be given in a future report.

Measurements of stream channel width and depth were made at transects in nine sections. This information documents the present condition of the stream channels and will also be related to density of game fish. Water temperature is being monitored using thermographs. Winter dissolved oxygen is diminished in portions of the East Fork. This problem is being investigated in depth. Bottom fauna samples were collected at nine stations.

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 sampling of larval fish and capturing of 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.

Game fish population estimates were made at eight locations. Most estimates have not been calculated, but combined game fish numbers are probably on the order of 200 to 400 fish per mile in much 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 earthfill 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

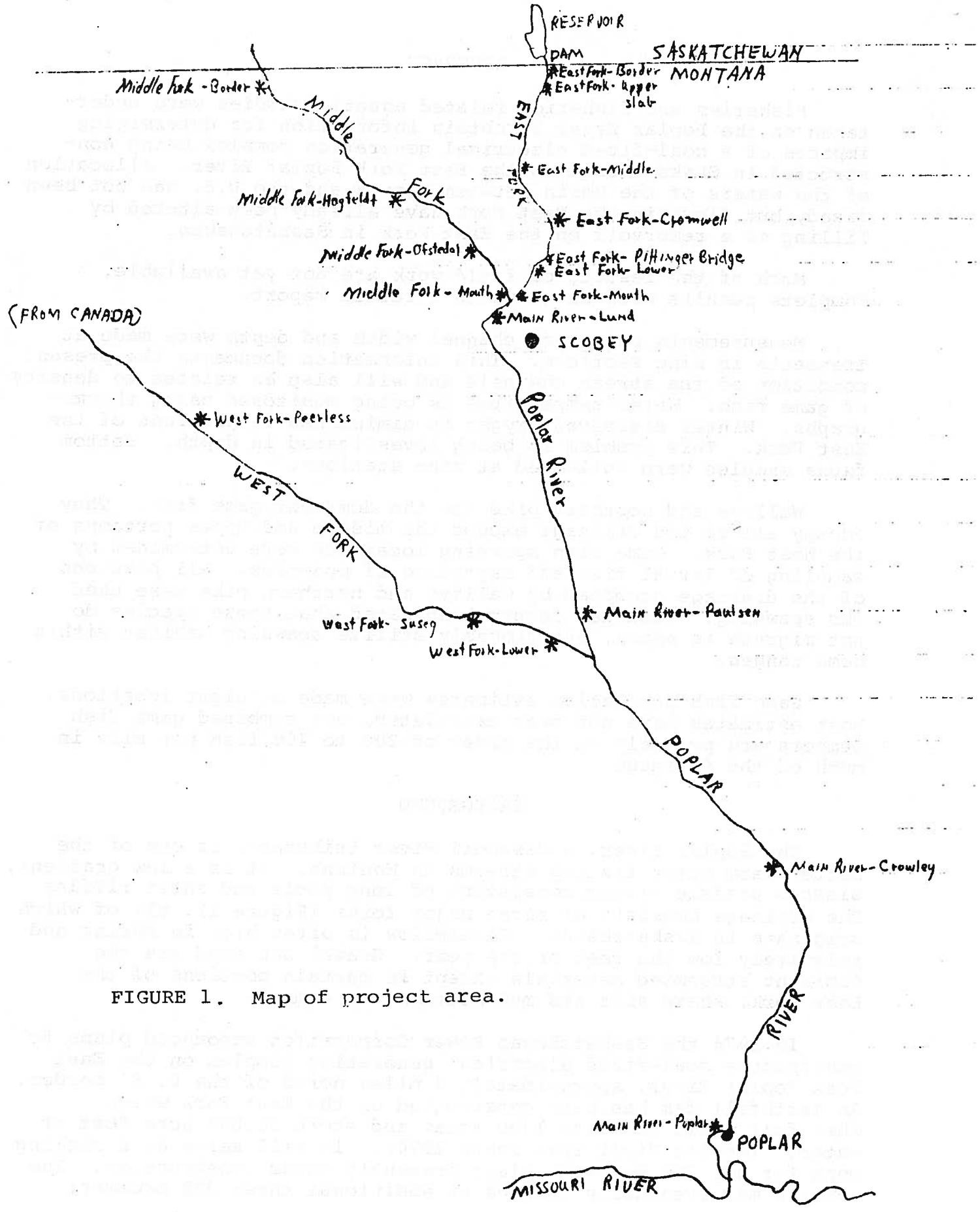

FIGURE 1. Map of project area.

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.

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.

Fish Studies

Larval Fish Sampling

Drifting larval fish were sampled with nets set in riffles. Planton 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.

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.

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:

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

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 were made at nine stream sections in June, July and August 1977. The locations were: Middle Fork-Border, Hagfeldt, Ofstedal; Main River - Lund, Paulsen; East Fork - Upper Slab, Cromwell, Lower; West Fork - Susag. These sections were from 1.5 to 2.0 miles in length.

Data workup and analyses have not been started. A few general observations can be made. The Poplar River is not deep. With the possible exception of the lower river (Crowley area and downstream), where measurements have not been made, most of the river is less than 5 feet deep. Pools are often long with distances of 0.5 miles between riffles not uncommon. Pool widths are mostly 50 to 100 feet.

Stream Temperature

Stream temperature measurements on the Poplar River are a cooperative effort with the U. S. Geological Survey. The USGS maintains a thermograph on the East Fork (Border location). 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 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 1. More complete data will be given in a later report. Temperatures increase rapidly following ice-out, reaching the 50 to 60 F range within a few days.

Table 1. Monthly maximum and minimum 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	4/6-11/19	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

Dissolved Oxygen

The existence of lowered dissolved oxygen levels during winter ice cover in the East Fork was discovered from USGS data (Table 2). 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 2. 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.

Weekly dissolved oxygen sampling was begun in December 1977 on the East Fork at the following stations: base of dam, border, upper slab, Cromwell and Pittinger Bridge. No firm conclusions can be drawn yet, but it appears that dissolved oxygen depression is greatest in the upper river and gradually decreases downstream.

Dissolved oxygen is also being measured at two stations on the West Fork (Susag and Peerless). The Peerless station is being used because game fish are not present in the middle area of the West Fork for unknown reasons. Dissolved oxygen may be part of the problem, but the first two samples do not indicate this. The Susag station on the West Fork is a "control" location.

Bottom Fauna

Samples were collected at nine stations in March, June and November 1977. Organisms are now being separated from the debris and sorted to taxonomic groups. Arrangements have been made with an outside consultant to identify the organisms beginning in January 1978. Results will be given in a later report.

Table 2. 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 from later unpublished USGS data.

Valves of a large clam were collected by hand picking from banks and shallow bottom areas. This clam is wide spread 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 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 are 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.

Larval Fish Sampling

Larval fish were sampled to obtain information on game fish spawning locations. Twelve stations were sampled two to four times per week from April 25 to June 2, 1977. Larval fish are presently being picked from the samples and identification has started. Walleye have been identified from some samples, but larval northern pike have not been found. Results will be given in a later report.

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 3. 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 3). 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.

Table 3. 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 3 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

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 3) would have been greater.

Aging of walleye and northern pike captured in April has begun, but most of this work remains to be done. This work should establish minimum age of spawners. Results will be given in a future report.

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 4 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 4).

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.

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

Table 4. 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.

utilize spawning habitat within home ranges. Movement of Missouri River fish into the lower Poplar River, however, has not been investigated.

The upper East Fork is an exception. There was a spawning run of northern pike into this area in April 1977. During April northern pike were present near the Upper Slab Station (Table 3). Only a single northern pike was captured at this station during 3½ days of electrofishing in September 1977.

Fish Population Estimates

In order to locate walleye rearing areas, population estimates for young-of-the-year (age 0+) were attempted by seining at several locations in the East and Middle Forks in September 1976. Older walleye and a few northern pike were also captured. Numbers of walleye captured were sufficient to make a population estimate only at the Pittinger Bridge location on the East Fork. Results are shown in Table 5. Mean estimates indicated 318 age 0+ and 326 age I and older walleye per mile.

Walleye population estimates were made for seven sections in 1977 (Table 6). Northern pike were also estimated where sufficient numbers were captured. The required fish aging and calculations have not been completed. Complete results will be shown in a future report. Estimates for young-of-the-year walleye will also be included except for sections on the East Fork, where survival of young-of-the-year walleye (and northern pike) was very low in 1977. Precision of these estimates will be mostly high because large percentages (typically 50-60 percent) of the fish present were captured on marking runs.

ADDITIONAL STUDIES NEEDED

Fish spawning in the lower river has not been investigated. It is highly probable that spawners move out of the Missouri River into the lower Poplar. Spawners should be tagged in this area. Return of tags from the Missouri River would indicate a spawning movement into the Poplar. Spawners should also be tagged at other Poplar River locations where ripe or spent females were not captured in 1977. Recapture of previously tagged fish will also give further information on spawning movement.

Fish population estimates have not been made in the lower river or in the upper Middle Fork. Estimates should be made at these locations to complete the survey. Estimates in the East Fork showed very low numbers of both walleye and northern pike young-of-the-year. These three sections should be repeated in 1978 to determine if young-of-the-year survival will continue to be low.

A determination of streamflows required to maintain fish populations is needed. Additional work needed toward this goal should be defined and completed.

Table 5. Walleye population data for a one-half mile stream section at the East Fork Poplar River - Pittinger Bridge location, September 1976.

Age Class	Mean Length (inches)	Mean Weight (pounds)	Estimated Number	Estimated Weight (pounds)	Fish Marked	Fish in Recapture Sample	Marked Fish in Recapture Sample
0+	5.0	0.04	159	5.85	62	29	11
I+	9.6	0.26	128	32.95)	56	42	14
II and older	13.3	0.83	35	28.68)			
Totals			322 (±95) [a]	67.48	118	71	25

a 95 percent confidence interval.

Table 6. Numbers of fish captured for making population estimates in seven stream sections in the Poplar River drainage.

Stream Section	Date	Walleye			Northern Pike		
		M	C	R[a]	M	C	R
Middle Fk. Poplar River - Hagfeldt	9/77	194	191	119	10	13	2[b]
Poplar River - Lund	9/77	108	119	69	73	97	60
Poplar River - Paulsen	10/77	112	141	86	94	124	59
East Fk. Poplar River - Border	9/77	20	18	14	1	0	0[b]
East Fk. Poplar River - Cromwell	8/77	117	129	66	50	85	15
East Fk. Poplar River - Lower	10/77	96	106	62	20	18	14
West Fk. Poplar River - Susag	11/77	146	182	113	7	5	3[b]
Totals		793	886	529	255	342	153

a M, C and R represent the number of fish marked, the number of fish in the recapture sample and the number of marked fish in the recapture sample, respectively.

b Number insufficient to allow population estimate.

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