MONTANA DEPARTMENT OF FISH AND GAME

FISHERIES DIVISION

JOB PROGRESS REPORT

State: Montana

Project No.: F-5-R-26 Title: Central Montana Fisheries Study

Job No.: I-a Title: Inventory and Survey of Waters in the Western Half of Region Four

Period Covered: July 1, 1976 to June 30, 1977

ABSTRACT

A total of 40 waters were inventoried during the report period. Several reservoirs were sampled to determine survival, growth and harvest of rainbow trout and kokanee. The later spring stocking date of rainbow trout appears to have better survival than earlier stocking as evidenced from experiments conducted at Bean Lake and Eureka Reservoir. Kokanee growth and harvest was determined for Bynum and Pishkun Reservoirs. Trends of burbot, northern pike and walleye were investigated at three other reservoirs. Northern pike and walleye were tagged in Tiber Reservoir and the first year tag return is 12.6 percent for northerns. Management of existing and potential farm ponds and small lakes was investigated. Electrofishing surveys were conducted on several streams and insect samples were collected from some of these streams that may be influenced by future oil and gas exploration. Information was gathered pertaining to the two-fish limit in the forks of the Sun River. Trout populations were estimated in three sections of the Smith River. An evaluation of angler harvest of catchable rainbow trout was conducted on the Missouri River near Giant Springs.

OBJECTIVES AND DEGREE OF ATTAINMENT

The long term objectives of this job are to inventory and survey waters of value or potential value for fisheries management in the western half of the Northcentral Region of Montana. Specific objectives in 1976-1977 were:

1. To determine growth and survival of hatchery rainbow in relation to stocking dates in Eureka, Bynum, Nilan and Willow Creek Reservoirs and Bean Lake. This work is included in this report.

2. To obtain information on survival, growth and harvest of kokanee in Pishkun and Bynum Reservoirs. This work was done and data are included.

3. To obtain trend information on northern pike, burbot and walleye populations in Tiber Reservoir, and northern pike and walleye populations in Lake Frances and Pishkun Reservoir. This information is included in this report.

4. To evaluate the present fishery management of farm ponds. New ponds were to be inspected to evaluate their potential for fishery management. Seventeen ponds were surveyed and results are included.

5. To determine species composition and relative abundance of fish in approximately 15 streams in the project area. Data are included for 14 streams.

6. To evaluate the effects of restrictive creel limits on trout populations in the upper Sun River and in the Smith River. This work was done and data are included in this report.

7. To determine water quality and species composition and relative abundance of aquatic invertebrates in the Badger Creek and Two Medicine River drainage. Insect samples were collected and preserved for analysis at a later date, but from different waters than listed. Water quality samples were not collected.

8. To obtain information necessary for minimum flow requirements for aquatic life in Belt Creek. Work was not done on this stream but preliminary data were gathered on Spring Creek at Choteau. Due to an error, the data are invalid and therefore not included in this report.

9. To evaluate the data collected in 1975 for recommending minimum flow requirments for aquatic life from streams in the Smith River drainage. This was not done due to time limitations.

PROCEDURES

Fish were sampled by a 50-foot seine (1/4-inch square mesh), 6 by 125-foot experimental gill nets (3/4-inch to 2-inch square mesh), 8 by 300-foot gill nets (1 1/4 to 1 3/4-inch square mesh),

3 by 4-foot and 4 by 6-foot frame net traps (1/4, 1/2 and 1-inch mesh), a 300-volt DC electrofish shocker, and by hook and line. Mark and recapture trout population estimates were conducted on the Smith River following procedures outlined by Vincent (1971 and 1974). Measurements of fish include total lengths to the nearest tenth of an inch and weights to the nearest hundredth of a pound. Scale and otolith samples were collected for age and growth studies. Hatchery rainbow trout were marked by clipping the adipose fin prior to planting into Bean Lake and Eureka Reservoir in the spring of 1976. Catchable (7-to 10-inch) rainbow trout were jaw tagged with a size 4 bandette tag prior to planting into the Missouri River. Six lots of 250 tagged trout per lot were released into the river over a three month period. Anglers were asked to voluntarily return the tags by depositing them in boxes set up near the river. Tags were collected weekly. Non-scheduled creel census were conducted at various times to determine fisherman harvest. Northern pike and walleye were tagged with T-tags and dart tags. Aquatic insects were collected with a Surber sampler.

ACCOMPLISHMENTS

Lakes and Reservoirs

Gill net summaries for the lakes inventoried are presented in Table 1. Individual discussion of various waters are included below.

Bynum Reservoir - Gill nets were fished in October to obtain a sample of kokanee as well as to obtain information on rainbow trout. No kokanee were collected in gill nets, however, data on mature fish was obtained from fishermen during the snagging season. A total of 140 kokanee were weighed and measured. Sixty-one males ranged in length from 13.4 to 17.5 inches (average 15.8) and weighed from 0.78 to 1.54 pounds (average 1.22). Females (79) ranged from 12.8 to 17.6 inches (average 15.0) and 0.57 to 1.50 pounds (average 1.04). Otolith samples were taken from 34 males and 35 females. Analysis of the otoliths indicate age classes II and III and IV+ were represented as shown in Table 2.

Bean Lake - Evaluation of survival of stocked rainbow trout in relation to spring stocking dates was continued. About 36,400 trout were planted April 7, 1976 and another 38,600 were planted on May 12 and 13, 1976. The adipose fin was clipped on 10,000 fish in the May plant which comprised 13.3% of the total plant.

The lake was gill netted on October 11 and November 4, 1976. Adipose clipped rainbow trout comprised 26% of the fish netted. The lake was netted again the following spring on April 19, 1977

Table 1. Summary of gill netting in lakes and reservoirs, 1976

Area (Date Sampled)	Surface Acres	No. of Nets	Species*	No. of Fish	Length Range (Average)	Weight Range (Average)
Bynum Res. (Oct. 6)	4,120	3	Rb	17	12.8-14.9(13.7)	0.70-1.10(0.86)
			Wf	15	9.8-15.8(11.9)	0.37-1.60(0.73)
			WSu	212		
Eureka Res. (Oct. 7)	408	2	Rb	23	8.9-12.3(10.0)	0.24-0.58(0.36)
			Rb	4	13.9-17.5(15.2)	1.00-1.43(1.23)
			LL	7	18.0-26+	2.22-9+
			WSu	120		
			Ln Su	45		
Lake Frances (Oct. 6)	5,500	3	NP	18	15.5-19.5(17.2)	0.80-1.87(1.15)
			NP	2	23.2-25.8(24.5)	3.06-4.11(3.59)
			WE	2	18.8-21.8(20.3)	2.64-4.13(3.39)
			YP	2		
Nilan Res. (Aug. 24)	500	1	Rb	11	10.0-14.3(12.8)	0.41-1.00(0.75)
			WSu	119	6.3-13.0(10.3)	0.10-0.90(0.50)
Pishkun Res. (Sept. 1)	1,550	6	NP	1	17.8	1.56
			Rb	1	21.3	3.59
			KOK	11	8.9-13.0(10.7)	0.24-0.83(0.49)
			KOK	3	13.9-15.0(14.3)	0.96-1.32(1.11)
			KOK	3	18.5-19.6(19.1)	2.11-2.24(2.16)
Tiber Res. (Sept. 28,29)	12,000	16	NP	48	17.3-22.2(19.8)	1.13-2.58(1.75)
			NP	5	25.6-28.3(27.2)	3.80-5.19(4.66)
			WE	161	15.0-20.2(17.7)	1.14-3.34(1.96)
			Rb	1	18.5	2.27
			YP	30	5.3-10.0(7.8)	0.05-0.43(0.18)
			SS	1		
			Carp	1		
			WSu	54		
			Ln Su	7		
Willow Cr. Res. (Aug. 24)	1,530	2	Rb	14	12.4-14.0(13.1)	0.68-1.04(0.81)
			WSu	56	6.2-14.4(11.4)	0.10-1.30(0.76)

* Species abbreviations: Rb-rainbow trout; Wf-mountain whitefish; WSu-white sucker; LL-brown trout; Ln Su-longnose sucker; NP-northern pike; WE-walleye; YP-yellow perch; KOK-kokanee; SS-shovelnose sturgeon.

and clipped fish from the 1976 plant comprised 22% of the catch. Marked trout planted in the spring of 1975 captured during the 1976 fall netting period comprised 22% of the total 1975 plant. The same numbers of fish were marked and planted in the lake in 1975 and 1976. This data reveals later planting dates have higher survival of fish. Because of variations in the percent of marked fish captured in gill nets, half of the entire lot of fish scheduled for Bean Lake in 1977 were marked with a fluorescent pigment. The marked fish were planted into the lake on April 28 while the unmarked fish were planted on March 23. Gill net sampling will be conducted in the fall of 1977 to compare survival between the two lots of fish. Similar plants of marked and unmarked fish were also made in Nilan, Willow Creek and Eureka Reservoirs.

Table 2. Age class, length and weight range of mature kokanee from Bynum Reservoir, October 25 and November 10, 1976

	Age Class	No. Fish	Length Range (Average)	Weight Range (Average)
Male	II	7	13.4-15.2(14.5)	0.78-1.12(0.98)
	III	26	13.9-17.5(16.3)	0.78-1.54(1.29)
	IV	1	15.5	1.23
Female	II	7	13.1-14.4(13.8)	0.76-0.92(0.86)
	III	23	12.8-16.3(15.1)	0.57-1.28(1.02)
	IV	5	16.0-17.6(16.7)	1.10-1.50(1.34)

Eureka Reservoir - Approximately 50,000 rainbow trout were planted on April 3, 1976 and another 50,000 were planted on May 4 and 5, 1976. Ten thousand of the latter plant were marked with an adipose fin clip to help determine which plant had the best survival. A similar experiment was conducted with the 1975 rainbow plant and the results indicated that the latter stocking date had better survival (Hill, 1976). Rainbow were examined for marks during gill netting surveys and in creels of fishermen. These sources indicated that 17% of the 1976 plant and 28% of the 1975 plant was marked. This data again indicates that the latter stocking date had better survival.

As evidenced in Table 1, rainbow trout growth in Eureka Reservoir is poor and is attributed to the buildup of suckers.

Plans for 1977 include no additional trout plants and rehabilitation of the reservoir in the fall. Fingerling trout will be stocked again in 1978.

Lake Frances - Trends in northern pike and walleye populations were determined by a gill net survey during October and the results are presented in Table 1. Although only two walleye were collected, the results are encouraging. These walleye represent fish stocked as fry in 1971 and natural reproduction, if any, will be determined in future surveys.

During 1976, fishermen returned two tags from northern pike tagged in 1972 and 1973. Accumulative returns for northern pike tagged in 1971 is 21.4%, for 1972 - 12.1% and for 1973 - 11.3%.

Pishkun Reservoir - Trap nets fished in April collected a total of 69 northern pike representing age groups II through VII. Gill nets were fished in September to sample kokanee with the results tabulated in Table 1. Attempts were made to collect walleye introduced in 1974 but none were taken.

Measurements and otoliths were secured from mature kokanee during the snagging season. Table 3 is a breakdown of size and age class of male and female as determined by analysis of otoliths. Mature males were represented by age classes II and III and females by age class III.

Pishkun Reservoir is becoming well known for producing large kokanee. In fact, the state record for kokanee was broken twice during the snagging season. On November 6, 1976, a male measuring 26.4 inches and weighing 5.53 pounds was snagged. Another male measuring 25.8 inches and weighing 5.94 pounds was snagged on November 12, 1976. Age of these fish is unknown.

A minimum flow of 15 cfs in the inlet ditch to Pishkun Reservoir was requested from the Greenfields Irrigation District during the spawning season to attract mature salmon. The request was granted until November 1 but failed to attract many kokanee. In the past, most of the mature salmon were observed in the vicinity of the inlet ditch but in 1976, most were snagged along the east shore.

Tiber Reservoir - A total of 45 trap net days from April 1 - 9 were expended in the Willow Creek Arm to follow trends in the northern pike, walleye and burbot populations. Surveys in September included 10 trap net days and 16 gill net days. Results of the September survey appear in Table 1. It is interesting to note that shovelnose sturgeon are still present in very limited numbers

Table 3. Age class and size of mature kokanee from Pishkun Reservoir, October - December, 1976

	Age Class	No. Fish	Length Range (Average)	Weight Range (Average)
Male	II	10	12.4-14.6(13.7)	0.68-1.06(0.89)
	III	20	18.7-22.7(20.7)	2.02-3.62(2.83)
Female	III	22	16.6-20.7(18.7)	1.53-3.08(2.04)

in the reservoir. This fish is native to the area and most were removed from the system when the drainage was rehabilitated prior to the gate closing at Tiber Dam. The only other sturgeon collected since the rehabilitation project was in 1968 (Baldes).

During the spring surveys, only five burbot were collected. The data compliments the scarcity of burbot in the creel of fishermen during the 1975-76 winter season. However, increased numbers have been reported taken during the 1976-77 season. One tag return was reported in February from a burbot tagged in the spring of 1975.

A total of 628 northern pike and 400 walleye were tagged with T-tags or dart tags in the Willow Creek Arm during April. Northerns tagged include 182 males averaging 22.5 inches (range 16.3-33.2), 217 females averaging 23.8 inches (range 20.6-39.0) and 229 immature fish averaging 15.1 inches (range 11.8-17.1). To date, 75 tags have been returned by fishermen and 4 tags were recovered during gill net surveys for 12.6 percent return. Female northern pike are more vulnerable to hook and line than are males as evidenced by the higher return rate of 19.4 percent of all females tagged as compared to 11.5 percent for males (immature fish tag return is 6.6 percent). This greater vulnerablity has also been reported at Pishkun Reservoir and Lake Frances (Hill, 1973). Tagged fish were reported taken throughout all areas of the reservoir.

A total of 386 male walleye tagged during April averaged 15.5 inches (range 13.2-19.4) while 14 females averaged 15.7 inches (range 14.4-17.0). Fishermen have returned only two tags from walleye and six more tags were recovered during gill net operations.

Scale samples taken during April were analyzed for 97 northern pike and 37 walleye. The ages and corresponding length range are presented in Table 4. Very good growth is shown for northerns

during the first two years of life. Good reproduction is also evident relating to 1974 and 1975. Natural reproduction of walleye has not been documented yet. Of the four years in which walleye were introduced into Tiber (1971-74), 1972 and 1973 appear to have had the best survival and reproduction from these age groups should begin to show up in netting surveys in 1977 and 1978 at the earliest.

Table 4. Age distribution of northern pike and walleye from Tiber Reservoir, April, 1976

Species	Age Class	No. Fish	Length Range
Northern pike	I	13	13.6 - 17.1
	II	58	18.7 - 24.7
	III	2	27.1 - 28.8
	IV	11	29.0 - 35.5
	V	3	32.7 - 36.0
	VI	6	37.0 - 38.0
	VII	4	37.8 - 39.0
Walleye	III	25	13.2 - 17.3
	IV	12	14.5 - 19.4

At the present time, the Bureau of Reclamation is rebuilding the spillway at Tiber Dam and have plans to add five feet to the elevation of the dam. This will enable them to manipulate the reservoir at the original operating levels. Tentative agreement has been reached with the Bureau to manipulate water levels when possible to allow growth of shoreline vegetation and then flood this area during northern pike spawning. Various flow regimes in the Marias River below the dam have also been agreed upon.

Small Lakes and Farm Ponds

A total of 17 small lakes or farm ponds were surveyed during 1976. One of these, Axtman Reservoir in Liberty County, has been removed from the management program as a new landowner wishes it to be a private pond.

Two ponds received introductions: largemouth bass and crappie into Ferris Pond in Teton County; and largemouth bass into Zell

Pond in Toole County. The latter pond experienced low water and oxygen levels during the winter of 1976-77 and possibly winter-killed.

Routine sampling (Table 5) was conducted for Stewart #1 (Chouteau County), Henry and Cameron Reservoirs (Toole County), Chester Pond (Liberty County) and Dickens and Swazee Lakes (Lewis and Clark County). Swazee Lake will be rehabilitated in 1977 to eradicate the sucker population and hopefully improve trout growth.

Table 5. Small lake and farm pond surveys, 1976

Area	Date Sampled	Sampling Gear*	Species**	No. Fish	Length Range
Stewart #1	July 7	H&L	Rb	5	12.5 - 14.1
Henry Reservoir	July 7	GN, H&L	Rb	10	6.6 - 12.3
Cameron Reservoir	July 7	H&L	Rb	8	7.2 - 13.1
Chester Pond	May 13	TR	Rb	4	11.9 - 12.4
Dickens Lake	Oct. 20	H&L	Rb	6	11.9 - 13.0
Swazee Lake	Oct. 20	GN	Rb	4	7.4 - 8.5
			WSu	20	7.0 - 16.0

* H&L=hook and line; GN=gill net; TR=trap net.

** Species abbreviations: Rb-rainbow trout; WSu-white sucker.

Water levels and fisherman success were checked at the following: Stephens Reservoirs 1 and 2 and Lock Reservoir (Teton County) and Myrvold Reservoir (Pondera County).

Bear Lake, a mountain lake in the Bob Marshall Wilderness, was visited. Observations were made on reported over-use around the lake by humans and horses. These reports do not appear to be true. The lake supports a self-sustaining population of yellowstone cutthroat. Samples taken by hook and line produced fish from 9.0 - 15.7 inches.

Three other ponds were surveyed and found to be too shallow for management. These include Virden Reservoir (Toole County) and Lake Theboe and a series of beaver ponds along the Teton River (Teton County).

Streams

Electrofishing Surveys - Electrofishing was conducted on 14 streams to determine species composition and relative abundance (Table 6). This work was done to update files and to obtain basic data on several streams that may be affected by oil and gas exploration.

Table 6. Electrofishing results on streams, 1976

Area (Date sampled)	Location (Length)	Species*	No. of fish	Length range (average)	Weight range (average)
Elk Creek (Aug. 26)	T19N,R7W,S21 (325')	Eb	19	3.1-11.3(6.7)	0.02-0.56(0.17)
		Rb	15	6.7-11.1(8.4)	0.10-0.50(0.23)
		LL	3	9.6-12.6(10.8)	0.32-0.80(0.51)
	T20N,R6W,S16 (325')	Rb	16	8.9-12.1(10.6)	0.24-0.62(0.41)
		LL	25	6.4-15.3(10.1)	0.09-1.60(0.46)
		Wf	1	12.2	0.67
	T20N,R6W, S 9 (350')	Eb	2	3.3- 3.6(3.4)	
		Rb	4	2.9-15.9	0.01-1.14
		LL	11	3.3-13.7	0.02-0.89
		Cot, Ln D, Ln Su			
Smith Creek (Aug. 26)	T20N,R8W,S36 (325')	Eb	10	3.4- 7.3(5.5)	0.02-0.16(0.07)
		Rb	6	4.3-13.3(7.7)	0.04-0.87(0.25)
Deep Creek (July 16)	T23N,R7W,S28 (350')	Wf	6	7.8-14.5(11.0)	0.17-1.16(0.56)
		Cot			
Waldron Cr. (July 26)	T25N,R9W,S16 (240')	Ct	2	8.6-10.8(9.7)	0.25-0.52(0.39)
		Wf	13	6.5-10.4(8.1)	0.10-0.35(0.20)
		Cot			
W. Fk. Teton R. (July 26)	T25N,R9W,S 6 (360')	Eb	2	6.0- 7.2(6.6)	0.10-0.16(0.13)
		Cot			
N. Fk. Teton R. (July 26)	T26N,R9W,S31 (200')	No fish			
Spring Creek (July 16)	T24N,R4W,S30 (360')	Eb	29	4.7-11.3(6.8)	0.04-0.60(0.16)
		Rb	8	6.8-12.3(9.6)	0.12-0.80(0.39)
		WSu,LnSu, Ln D, Cot			

Table 6. Continued.

Area (Date sampled)	Location (length)	Species*	No. of fish	Length range (average)	Weight range (average)
South Fk. Dupuyer Cr. (July 14)	T27N,R9W,S35 (350')	Ct	6	2.3- 9.8(5.6)	0.02-0.37(0.13)
North Fk. Dupuyer Cr. (July 14)	T27N,R9W,S22 (850')	Eb	4	6.5-10.6(8.4)	0.14-0.38(0.24)
		Ct	4	7.6-10.5(9.3)	0.18-0.46(0.35)
Dupuyer Cr. (Aug. 3)	T28N,R8W,S23 (770')	Eb	22	2.6-10.4(5.3)	0.01-0.38(0.10)
		Rb	5	6.7-12.0(9.1)	0.09-0.53(0.29)
		Wf	3	3.1-11.5(6.7)	0.03-0.41(0.17)
		Cot, LnSu			
Jones Creek (July 23)	T26N,R4W,S20 (325')	LL	1	18.8	2.40
		WSu, Ln D			
S. Fork Two Medicine R. (July 29)	T30N,R13W,S15 (300')	Ct	2	5.5- 7.4(6.5)	0.07-0.17(0.12)
		Wf	4	9.3-11.9(11.1)	0.29-0.58(0.44)
		JSu, Cot			
Summit Creek (July 29)	T30N,R13W,S15 (260')	Rb	1	7.7	0.16
		Ct	3	4.4- 6.7(5.5)	0.03-0.10(0.06)
		RbxCt	1	6.0	0.08
		Wf	3	10.8-13.8(11.8)	0.37-0.67(0.48)
	T30N,R13W,S29 (125')	Ct	7	3.0- 6.1	0.02-0.08

* Species abbreviations: Eb-brook trout; Rb-rainbow trout; LL-brown trout; Wf-mountain whitefish; Cot-sculpin; Ln D-longnose dace; LnSu-longnose sucker; Ct-cutthroat trout; WSu-white sucker; JSu-mountain sucker; RbxCt-rainbow-cutthroat hybrid.

Inventory shocking was also conducted on the Marias River south and west of Shelby in which approximately eight miles of river was boat shocked. The sampling gear was ineffective but burbot, whitefish and suckers were observed.

North and South Forks Sun River - Information was collected for the second consecutive year on the forks of the Sun River in relation to the two-fish kill limit imposed in 1975. Project personnel sampled fish by hook and line and also observed fish in fishermen's creels. Species composition and length measurements were made for all fish observed and scales were taken from a representative sample (Table 7). Age analysis is presented for rainbow trout only. Although the average size of trout in 1976 increased somewhat over the 1975 data, it is too early to tell if the new limit is responsible for the increase. It will be necessary to continue the survey for several years to obtain sufficient data to make definite conclusions.

Table 7. Length and age class distribution of fish in the North and South Forks of the Sun River, August 9-11, 1976

Stream	Species*	No. Fish	Length range (average)	Age class	No. Fish	Length range (average)
North Fork Sun River	Ct	5	8.0-14.5(10.6)			
	Eb	7	6.8-11.0(8.5)			
	RbxCt	3	12.3-14.6(13.8)			
	Rb	96	6.0-15.8(11.3)	I	4	6.0- 7.7(6.9)
				II	11	7.4- 9.4(8.7)
				III	53	9.3-13.5(11.1)
				IV	20	11.5-15.4(12.8)
				V	8	13.8-15.8(14.8)
South Fork Sun River	Ct	1	14.0			
	Eb	11	7.7-14.0(10.2)			
	RbxCt	7	9.8-13.8(11.9)			
	Rb	102	6.6-17.4(11.8)	I	2	6.6- 7.4(7.0)
				II	11	7.6-10.0(8.7)
				III	51	8.9-15.0(11.6)
				IV	31	10.8-16.7(13.0)
				V	4	13.8-17.4(15.8)

* Species abbreviations: Ct-cutthroat trout; Eb-brook trout; RbxCt-rainbow-cutthroat hybrid; Rb-rainbow trout.

Smith River - Trout population estimates were conducted in three sections of the Smith River in September, 1976. This work is a continuation of evaluating the effects of a restricted creel limit on trout populations in the river. The special limit became effective in May, 1975 from the mouth of the river near Ulm, Montana to the mouth of Sheep Creek, a distance of 80 river miles. The Fraunhofer and Zieg sections lie within the river area influenced by the special creel limit of two rainbow and/or cutthroat trout. The Loney Section lies about 25 river miles upstream from the boundary where the special limit is in effect.

Trout population estimates from the three sections are presented in Tables 8, 9 and 10. Population estimates reveal the number of rainbow trout increased over 50% since 1975 in the Loney and Zieg Sections while the number of brown trout increased only in the Zieg Section. Total biomass of trout increased considerably in both sections (Tables 8 and 9).

Table 8. Trout population estimates from Loney Section on the Smith River, September, 1976

Species	Age	Length range (inches)	Number	Weight (pounds)
Rainbow trout	I	5.4 - 9.2	261	44.02
	II	8.0 - 12.1	194	77.51
	III	10.0 - 14.8	136	81.47
	IV & Older	12.1 - 16.7	70	61.69
			661(±82)	264.69(±27)
Brown trout	I	7.1 - 10.2	68	16.77
	II	9.7 - 13.6	44	27.87
	III	11.0 - 16.5	120	153.41
	IV & Older	15.5 - 21.7	78	143.91
			310(±37)	341.96(±48)
Brook trout	I - III	6.5 - 11.9	104(±31)	40.00(±12)
Grand Total			1,075	646.65
Standing crop per 1,000 feet			127	76.7
Standing crop per acre			126	75.5

Table 9. Trout population estimates from Zieg Section on the Smith River, September, 1976

Species	Age	Length range (inches)	Number	Weight (pounds)
Rainbow trout	I	5.3 - 8.1	815	96.99
	II	7.8 - 11.0	703	222.71
	III	9.3 - 13.8	388	184.77
	IV & Older	11.3 - 15.7	148	110.38
			2,054(±240)	614.85(±67)
Brown trout	I	7.8 - 9.4	only 4 captured[1/]	
	II	10.2 - 15.0	40	33.44
	III	13.4 - 17.0	103	167.08
	IV & Older	16.1 - 24.0	16	33.38
			159(±40)	233.90(±65)
Grand Total			2,213	848.75
Standing crop per 1,000 feet			206	78.95
Standing crop per acre			106	40.55

1/ Not included in estimates.

Only rainbow trout were estimated in the Fraunhofer Section because too few brown trout were collected for a suitable estimate. Estimates were not made in this section in 1975 because of sampling difficulty. The number of older and larger rainbow trout increased considerably compared to an estimate made in 1970. However, fewer yearling and two-year old rainbows were found compared to 1970. Sample size was adequate for calculating these estimates, so the definite paucity of two-year olds and decrease of yearlings in the population (Table 10) is probably the result of environmental factors.

The apparent increase in the trout populations in the upper Smith River is undoubtedly due to improvement of the habitat via water quantity. Late summer flows were noted to hold up well due

to above normal precipitation in 1975 and 1976. The apparent decrease of yearling and two-year old trout in the Fraunhofer Section may have been caused by the 1975 flood. The lower canyon area of the river was subjected to a flood flow considered to be of a 100 year frequency. This high flow probably had disastrous effects on newly hatched young of the year and the small yearling trout. Collection of population data will be continued in order to obtain the necessary information for evaluating the restricted kill regulation. Data collected to date indicate environmental stresses appear to have greater effects on the trout population than angling pressure.

Table 10. Trout population estimates from Fraunhofer Section on the Smith River, September, 1976

Species	Age	Length range (inches)	Number	Weight (pounds)
Rainbow trout	I	6.7 - 9.9	288	66.83
	II	10.7 - 11.9	18	9.58
	III	10.6 - 13.9	70	46.44
	IV & Older	11.6 - 17.1	72	72.51
			448($\pm$77)	195.36($\pm$34)
Grand Total			448	195.36
Standing crop per 1,000 feet			37	16.28

Rocky Mountain Front Water Quality Study - The east slope of the Rocky Mountain Front south of Glacier Park is thought to have potential for oil and gas. Exploration on Forest Service and BLM lands will possibly begin in 1978. Some drilling occurred on private land during 1976. Several streams in this area could be affected by exploration. During 1976, aquatic invertebrate bottom samples (3 square feet per station) were collected in the following streams: North and South Forks of Dupuyer Creek; North, South and West Forks of Teton River; and Waldron Creek. The samples have been preserved for analysis at a later date. Composition

of fish species in these streams, with the exception of the South Fork of Teton River, was reported on earlier in this report (Table 6). Water quality was not investigated during this report period. Future surveys will gather additional information on the insect community, water quality and species composition and relative abundance of fish.

Spring Creek - Flow measurements and water surface profile data was gathered on Spring Creek in Teton County following the guidelines of Spence (1975). After the measurements were made, an error was found at one of the transects, making the data unusable. All measurements will have to be redone prior to making application for a flow reservation.

Missouri River - In 1976, the Department of Fish and Game fish planting policy was implemented into Montana Administrative Codes. Two of the requirements for stream planting of catchable-size trout (7 inches or longer) within this policy are: (1) For each six fish planted there must be an average increase of at least one fisherman day on the water stocked, and (2) At least 40% of the planted fish must be creeled.

Catchable-size rainbow trout have been stocked in the Missouri River by Giant Springs for several years. Since the area is readily available to the public and fishing pressure is concentrated in a small area, the catchable program lent itself to relatively easy evaluation. Six lots of jaw tagged rainbow trout were periodically stocked in the river throughout the summer. Anglers catching tagged fish were asked to voluntarily return the tags in one of four boxes set up at various locations on the river bank. Voluntary return appeared to be good since over 50% of the tags were returned from four of the lots of tagged fish. Results of the harvest of tagged fish are presented in Table 11.

Table 11. Percent of tags returned by fishermen from catchable rainbow trout planted in the Missouri River near Giant Springs

Days after planting	Planting dates 6/10/76	6/24/76	7/9/76	7/28/76	8/19/76	9/16/76
30	37	47	43	43	21	4
60	11	5	5	4	2	8
90	<1	1	2	4	3	2
120	<1	1	<1	<1	0	0
150	1	<1	0	<1	3	7
180	0	1	1	0	<1	2
Total Returned by 7/1/77	50	56	52	52	31	25

Most of the tagged fish caught from each lot were taken within the first 30 days after liberation except for the fish stocked in September. Results of this experiment reveals the requirements for stocking catchable trout near Giant Springs are being met up to about September 1. It is recommended that catchable trout continue to be planted in the river near Giant Springs until Labor Day weekend.

Two main factors for lower catch rates after Labor Day are decreased fishing pressure and cooling of the river water. The stocked trout apparently utilize the area of river influenced by cool water from Giant Springs during the summer. As the river water cools in the fall, the trout apparently disperse away from the springs area and become less available to fishermen.

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Prepared by: William J. Hill and Alfred H. Wipperman

Date: June 30, 1977

Code numbers of waters referred to in this report are:

14-1320	Deep Creek
14-1640	Dupuyer Creek
14-2560	Jones Creek
14-3280	Marias River
14-3840	North Fork Dupuyer Creek
14-4000	North Fork Teton River
14-5480	South Fork Dupuyer Creek
14-5640	South Fork Teton River
14-5680	South Fork Two Medicine River
14-5760	Spring Creek
14-5960	Summit Creek
14-6360	Waldron Creek
14-6480	West Fork Teton River
14-6860	Axtman Reservoir
14-7080	Bynum Reservoir
14-7120	Cameron Reservoir
14-7140	Chester Pond
14-7320	Eureka Reservoir
14-9180	Ferris Pond
14-7440	Lake Frances
14-7620	Henry Reservoir
14-8060	Lock Pond
14-8250	Myrvold Reservoir
14-9080	Stephens Reservoir #1
14-9081	Stephens Reservoir #2
14-9091	Stewart Reservoir #1
14-9200	Lake Theboe
14-9240	Tiber Reservoir
14-9490	Virden Reservoir
14-	Zell Pond
17-4880	Missouri River
17-6832	Smith River
17-8720	Bean Lake
20-2000	Elk Creek
20-4400	North Fork Sun River
20-5500	Smith Creek
20-5600	South Fork Sun River
20-6950	Bear Lake
20-7130	Dickens Lake
20-7900	Nilan Reservoir
20-7950	Pishkun Reservoir
20-8300	Swazee Lake
20-8500	Willow Creek Reservoir

MONTANA DEPARTMENT OF FISH AND GAME
FISHERIES DIVISION

JOB PROGRESS REPORT

State: Montana

Project No.: F-5-R-26 Title: Central Montana Fisheries Study

Job No.: I-b Title: Inventory of Waters in the Eastern Half of Region Four

Period Covered: July 1, 1976 to June 30, 1977

ABSTRACT

Netting surveys were conducted on 12 ponds and reservoirs in the project area. Twelve BLM reservoirs and ten private ponds were inspected. Black crappies were transplanted into one pond and largemouth bass into two ponds. Streambank stabilization projects on Big Spring Creek were documented and monitored. Invertebrate bottom samples were collected from the established stations along Big Spring Creek. Trout population estimates were made for two sections of Big Spring Creek. Rainbow trout estimates were below estimates made in 1974 by 61% in one section and 55% in the other section. Brown trout numbers were also down 35% and 39%. Netting surveys were conducted in the Missouri River above Fort Peck Reservoir. Electrofishing inventories were done in several tributaries of Cottonwood Creek and in a tributary of Flatwillow Creek. Erosion transects were measured along the Lost Fork of the Judith River. Smallmouth bass were planted into Warm Spring Creek in 1976 and 1977.

OBJECTIVES AND DEGREE OF ATTAINMENT

The objectives of this job were:

1. To evaluate present management of fish populations in Ackley, Bair, Martinsdale, North Fork Smith River, Petrolia, War Horse, and Yellow Water Reservoirs. This was done and the findings are included. Periodic checks were also made to determine angler harvest and success in these waters.

2. To evaluate present fishery management of farm ponds. This was done for a number of ponds and netting results from several ponds are included.

3. To obtain information necessary for minimum flow requirements for aquatic life in Warm Spring Creek. This work was not done on Warm Spring Creek but instead emphasis was placed on obtaining this information for Smith River and several of its tributaries.

4. To evaluate management of trout populations in Big Spring Creek. This was done and the findings from several population estimates are included.

5. To evaluate environmental changes in Big Spring Creek in respect to changes in watershed management practices. This was done and the findings are included.

6. To evaluate the status of fish populations and habitat conditions in several tributaries in the upper Musselshell and Judith River drainages. This was done for several tributaries and the findings are included.

PROCEDURES

Fish were sampled with sinking and floating nylon gill nets, 125 x 6-foot (with graduated mesh sizes from 3/4 to 2-inch); 4 x 6-foot frame trap nets (1/2 and 1-inch mesh); 3 x 4-foot frame trap nets (1/4-inch mesh); a 300-volt D.C. electrofish shocker; a 0-500 variable voltage D.C. electrofish shocker; and by hook and line. Fish captured were measured to the nearest tenth of an inch (total length) and weighed to the nearest hundredth of a pound. Scales were collected for growth analysis. Bottom sampling in streams was done with a Surber Sampler. Population estimates for Big Spring Creek were made using the mark and recapture method described by Vincent (1971 and 1974). Electrofishing on other streams consisted of making one pass through each section without the use of blocking nets. These streams were all small, having flows less than 5 cfs.

ACCOMPLISHMENTS

Large Reservoirs

All seven large Department of Natural Resources reservoirs located within the Central Montana Study area were surveyed during 1976 and 1977 and the findings are summarized in Table 1. Irrigation withdrawals from

Table 1. Summary of netting data from large lakes and reservoirs, 1976.

Location (Date Sampled)	Surface Acres	Number and Type of Net	Species*	No. of Fish	Length Range - Inches (Average)	Weight Range - Pounds (Average)
Ackley Lake			Rb	5	1977 Plants	-
May 18-19 1977	247	2-gill	Rb	4	10.6 - 16.0 (13.7)	0.48 - 1.40 (1.03)
			WF	1	12.0	0.68
			FSU	133	-	-
			CSU	134	-	-
Bair Reservoir			Rb	19	1976	-
June 23-24 1976	272	2-gill	Rb	37	18.6 - 10.8 (11.9)	0.50 - 2.00 (0.63)
			Eb	13	6.9 - 12.0 (9.0)	0.15 - 0.74 (0.36)
			CSU	335	-	-
Martinsdale			Rb	2	1976 Plants	-
Reservoir	985	3-gill	Rb	44	11.5 - 17.5 (12.9)	0.52 - 1.90 (0.76)
July 1-2 1976			LL	3	10.9 - 15.3 (13.3)	0.52 - 1.30 (0.87)
			CSU	95	-	-
			FSU	7	-	-
Petrolia			WE	38	8.3 - 29.0 (15.8)	0.12 - 10.30 (2.06)
Reservoir			GE	2	16.4 - 17.3 (16.8)	1.50 - 2.06 (1.78)
Oct. 8-12 1976	515	4-trap	CARP	32	-	-
			CSU	55	-	-
April 11-13 1977		3-trap	WE	4	9.4 - 24.1 (14.9)	0.25 - 4.59 (1.47)
			CARP	63	-	-
			CSU	1	-	-
Smith River			Rb	19	11.5 - 12.6 (11.9)	0.60 - 0.80 (0.70)
Reservoir	327	2-gill	WF	1	11.8	0.60
June 23-24 1976			CSU	274	-	-
War Horse	1000	4-trap	NP	2	Adults	-
Reservoir			CARP	±2500	-	-
Oct. 12-13 1976			CSU	±2500	-	-
April 10-12 1977		4-trap	NP	27	Adults	-
			CARP	1587	-	-
			CSU	978	-	-
Yellow Water	600	2-gill	Rb	15	16.2 - 20.2 (17.7)	2.40 - 4.20 (3.03)
Reservoir			Rb	29	1976 Plants	-
June 21-22 1976			CSU	44	-	-

*Species Abbreviations: Rb - Rainbow trout; LL - brown trout; WF - mountain whitefish; Eb - brook trout; FSU - longnose sucker; CSU - white sucker; WE - walleye; GE - goldeye; NP northern pike

these reservoirs during the report period were moderate to heavy and by late fall water levels were quite low in several of the reservoirs. A short narrative summary of the findings in each reservoir follows. Management recommendations are included in this section.

Ackley Lake - Fishing success in Ackley Lake declined during 1976 and 1977. This was probably due to the rapid build up of rough fish populations. Netting surveys conducted since 1973, when the lake was rehabed, indicated a slow build up of sucker populations until this year. Nets set during May 1977 took 30 suckers for every trout which was a considerable change from the 5 to 1 ratio of trout to suckers found in 1975. Fishermen interviews over the past year also reflected a decline in fishing success. Since past experience with Ackley Lake has shown that kokanee survival appeared better than rainbows with high sucker populations (Poore 1973) my recommendation for 1978 is to cut the rainbow plant in half and also plant kokanee.

Bair Reservoir - Netting surveys in Bair Reservoir showed suckers outnumbering trout about 5 to 1. In spite of a large rough fish population, growth and survival of trout remained relatively good.

Martinsdale Reservoir - Netting surveys on Martinsdale Reservoir showed suckers outnumbering trout about 2 to 1. This data corresponds closely with that collected in 1975 indicating that rough fish populations have stabilized at tolerable levels. The presence of brown trout in the lake probable helps control rough fish populations. Fishing success has been good for several years and the lake remains a favorite with many anglers.

Petrolia Reservoir - Water levels in Petrolia were lower in 1976 than in prior years because of heavy irrigation withdrawals. Trap netting during the fall took a number of walleyes representing many age classes. Trap nets set during the spring of 1977 did not take many fish because the reservoir was again full of water. No perch from the 1975 introduction or burbot from the 1973 introduction were taken during either netting. The status of the burbot introduction remains a mystery since the last burbot were netted in 1974.

Smith River Reservoir - Following rehabilitation of the reservoir in 1973, sucker populations have again built up to undersirable levels. One consolation of having a large rough fish population is that it should provide a good source of food for burbot introduced into the reservoir during 1975. Netting data indicates suckers outnumber trout 14 to 1. The vast majority of the trout sampled appeared to be from the 1975 plant. There were also indications of poor survival of plants from several other years.

War Horse Reservoir - Trap nets set in the reservoir during the past several years indicate northern pike introduced in 1973 have not been able to spawn successfully. The only pike taken during 1976 and 1977 were adults from the original introduction. No largemouth bass were taken either year. High carp populations and declining water levels have apparently inhibited reproduction of bass and pike.

Yellow Water Reservoir - Growth and survival of trout in Yellow Water has been very good. Netting during 1976 indicated a 1 to 1 ratio of trout to suckers. Unconfirmed reports of trout being caught weighing up to 6 pounds were received in early 1977. The lake has been popular with fishermen from Billings. Water levels may become critical this fall (1977) because of heavy irrigation use and reduced runoff within the watershed.

Plans for 1977 and 1978 include netting in all seven large reservoirs to evaluate present management and fish population trends. Occasional creel checks are also planned to monitor fishermen success. Extreme drouth conditions in some areas may make rehabilitation of several large reservoirs feasible by late fall.

Farm Ponds

Results of netting in five small ponds stocked by the Department of Fish and Game are given in Table 2. Several ponds stocked by the State were removed from the planting program when landowners decided to raise fish for commercial purposes.

Twelve BLM reservoirs and ten private ponds were checked to see if they might support fish. As a result of these investigatigations several ponds were added to our planting program. Black crappies were transplanted into one pond and largemouth bass were transplanted into two ponds.

Plans for 1977 and 1978 include test netting in twelve small state stocked reservoirs to check on growth, survival and abundance of game fish vs non-game fish. Occasional creel checks are also planned on the more important ponds to provide fishing success and fishing pressure information.

Streams

Big Spring Creek - Even though flows in Big Spring Creek were normal during 1976, stream habitat continued to deteriorate because of unstable conditions aggravated by major flooding in 1975. Massive bedload deposits in the stream channel and unstable stream gradients contributed to the problems.

Table 2. Results of sampling small ponds and reservoirs, 1976

Pond (year)	Number of Gill Nets	Species*	No. of Fish	Length Range - Inches (Average)	Weight Range - Pounds (Average)
Bell Reservoir (1976)	1	Rb	14	11.1 - 13.8 (12.4)	0.5 - 1.10 (0.71)
		CSU	60	-	-
East Fork (1977)	2	Rb	37	1977 Plants	-
		Rb	39	9.8 - 13.5 (12.3)	0.40 - 0.84 (0.64)
Spring Creek Reservoir		Eb	1	8.7	0.21
		CSU	92	-	-
		FSU	12	-	-
Normans Pond (1976)	1	Rb	37	8.7 - 17.5 (10.7)	0.28 - 2.30 (0.58)
Rhoda Lake (1976)	1	Ct	18	-	-
Rindal Reservoir (1976)	1	Rb	11	8.8 - 10.1 (9.6)	0.28 - 0.42 (0.35)

Species* Abbreviations: Rb - rainbow trout; Eb - brook trout; Ct - cutthroat trout; CSU - white sucker; FSU - longnose sucker

Several 216 emergency watershed protection projects designed by the S.C.S. were began in an attempt to stabilize the stream in certain critical areas. One major project downstream from Lewistown which included channel dredging, riprapping, bank shaping, diking, re-vegetating and fencing was nearly completed. Several other major projects scheduled to begin in 1977 involve the construction of grade stabilization structures. A new highway bridge across Big Spring Creek was recently completed. Most of the stream stabilization work being done today was caused by a major channel alteration done by a private individual in 1961. Considerable time was spent during 1976 and 1977 documenting and monitoring the various projects involving Big Spring Creek that have resulted from this channel change. Additional time was involved with various inter-agency communications, coordination meetings and recommendations involving Big Spring Creek.

The Big Spring Creek Watershed Project is nearly completed. Of the five watershed dams originally proposed, Hanson Creek, East Fork, Casino Creek and Pike Creek dams are now completed. Only the dam on Castle Creek remains to be built. Of all the dams built to date, Castle Creek should have had one of the highest priorities because of the poor condition of the watershed. It is questionable whether Castle Creek dam will be built because of funding problems.

Invertebrate bottom samples were collected from the nine established stations along Big Spring Creek and the results are given in Table 3. It appears that invertebrate bottom organisms have been very slow to recover from the devastating flood of 1975. The total number of organisms from all stations combined for 1976 (2193) was slightly lower than for 1975 (2228) even though we had no high water in 1976. Total organisms sampled during the years 1972 through 1974 varied from about 5300 to 6200. The depressed number of invertebrates is probably one of the factors contributing to low fish population estimates for Big Spring Creek.

Trout population estimates were made for two sections of Big Spring Creek in the fall of 1976. The 1976 and 1974 estimates are included in Table 4. Section B is located upstream from Lewistown and section D is located downstream from town (Poore 1975). Data for both estimates was treated with the fish population statistics computer program.

Rainbow trout estimates for 1976 were down 61% in section B and 55% in section D when compared to estimates from 1974. Estimates for brown trout were also down 35% in section B and 39% in section D. Total weight estimates for both species in both sections were also down but not as drastically as total numbers indicating an increase in average size. This becomes more clear when we look at the age structure of the fish populations from each section. In section B, we found almost a complete absence of rainbow trout from age group I and of brown trout from age group I and II. In section D the big decrease in the total number of rainbows was also in age groups I and II with an increase in age groups III and older. Brown trout in section D showed the same pattern except for the IV and older group which showed a decrease.

Table 3. Numbers and families of organisms collected in two one-square foot bottom samples from nine stations on Big Spring Creek and East Fork on July 22, 1976.

Organism	Hatchery	East Fork	Burleigh's	Montana Power	St. Leo's School	Above Sewer	Below Sewer	Trestle	Spring Cr Colony
Tricoptera									
Bracycentridae	472	12	161	512	26	56	39	61	4
Leptoceridae	57		137	21	18	13	13	4	
Rhyacophilidae	40		24	43	3	15	15	48	7
Hydropsychidae	8		7	11	2	2	6	10	2
Helocopsychidae	1							1	
Gastropoda									
Planorbidae	1	3	2	1					
Physidae		3	1			1			
Diptera									
Tipulidae	1	9	6	82	1	14	4	37	5
Tendipedidae							1		17
Rhagionidae		34		1		1	1		3
Tricladida									
Planariidae						2		1	
Epemeroptera									
Baetidae	19		7	27	2	2	39	3	4
Heptageniidae	17		3				5		
Plecoptera									
Perlodidae	3			5	1		2		
Annelida									
Oligochaeta	1				1		1		
Pelecypoda									
Sphaeriidae			1						
Station Totals	620	61	349	703	54	106	126	165	42
Aug. No./Sq. Ft.	310	30	174	351	27	53	63	82	21
No. of Families	14	4	11	10	9	11	11	11	8

Table 4. Summary of trout population estimates in two sections of Big Spring Creek 1974 and 1976.

Species	Year	Total number per section Section B	Section D
Rainbow trout	1974	1,165	1,268
Rainbow trout	1976	450	567
Brown trout	1974	100	243
Brown trout	1976	65	149
	Total weight per section		
Rainbow trout	1974	524	568
Rainbow trout	1976	263	376
Brown trout	1974	148	195
Brown trout	1976	89	128

Total number per section					
Age Group	1974	1976	Age Group	1974	1976
Section B - Rainbow trout			Section D - Rainbow trout		
I	536	-	I	639	182
II	570	290	II	551	124
III	48	125	III	69	170
IV & older	10	9	IV & older	6	91
Brown trout			Brown trout		
I & II	40	-	I	80	38
III & older	56	65	II	103	33
			III	38	65
			IV & older	21	13

Lack of recruitment into the population in both sections for both species was probably the result of the major flooding which occurred in 1974 and 1975. Flood flows scoured the banks and bottom of the stream for a four to six week period when incubating eggs and small fry would normally be present. Another major factor influencing trout populations was the decline in aquatic invertebrates so important as food organisms. The decline of aquatic invertebrates was probably the result of bottom scouring by flood waters. Besides the detrimental affect of scouring, flood waters destroyed considerable fish habitat by washing away undercut blanks and overhanging brush.

Population estimates are planned for the same two sections again in 1977. Major portions of section D have been altered as part of a streambank stabilization project. This provides a good opportunity to monitor the response of the fish population to this major physical disturbance. If the project has accomplished the desired objectives of stabilizing the stream, an increase in the fish population should be seen over the next several years. Another part of the project calls for extensive streambank fencing to exclude livestock and allow vegetation to become re-established. The rate and extent of re-vegetating along the streambanks will be closely monitored.

Missouri River - Limited sampling was carried out on the Missouri River immediately above Fort Peck Reservoir and the results are given in Table 5. This sampling is part of a project to gather baseline fisheries information in the last free-flowing stretch of the river. Frame trap nets were fished during the fall of 1976 and spring of 1977. Many of the game fish taken during 1977 were tagged with individually numbered tags in cooperation with the Middle Missouri River Planning Project (Berg 1976). In addition to trap netting in the river, time was spent tagging paddlefish. This data was transferred to the Middle Missouri River Planning Project.

Other Streams - Electrofishing data collected on other streams is included in Table 6. Four short sections on two tributaries of Cottonwood Creek were electrofished to gather fishery inventory data. Several areas along both tributaries have been subjected to logging. Also included in the table is data collected from McCartney Creek which is a major tributary to the North Fork of Flatwillow Creek.

Erosion transects established in two locations along the Lost Fork of the Judith River in the fall of 1968 were re-measured in 1976 and 1977. The area has a history of over-grazing along the stream bottom. A jeep trail up the bottom which contributed to erosion problems through numerous stream crossings was closed to vehicle traffic several years ago. Livestock did not use the area from 1971 until 1976. Data given in Table 7 shows erosion rates were relatively low during this period when we consider that major flooding occurred in 1974 and 1975. A considerable amount of bank erosion occurred from June 1976 to June 1977, which could be related to heavy livestock use as part of a new rest rotation grazing system. Another contributing factor could have been a number of elk which wintered along the Lost Fork during 1976.

A number of photos were taken of the two transects areas and fish populations were sampled with hook and line in several locations. A more detailed study is planned over the next couple of years.

In July, 1976, 5000 smallmouth bass were planted into Warm Spring Creek. Unconfirmed reports have been received of fishermen catching an occasional 2 pound smallmouth from the 1973 introduction.

Plans for 1977 and 1978 include limited stream inventory work in tributary streams of the Musselshell and Judith River drainages.

Table 5. Netting results from the Missouri River; 1976-1977

Date (year)	Number of Trap Nets	Species*	Number of Fish	Length Range - Inches (Average)	Weight Range - Pounds (Average)
Sept. 21-23 (1976)	3	SA	72	9.0 - 22.7 (14.7)	0.19 - 4.14 (1.03)
		Ling	4	21.4 - 29.8 (26.4)	2.00 - 6.20 (4.23)
		NP	4	24.0 - 39.8 (31.9)	2.70 - 13.20 (7.95)
		BCR	11	6.6 - 10.0 (7.6)	0.19 - 0.68 (0.29)
		STUR	1	26.3	1.80
		C.Cat	3	16.3 - 22.2 (18.9)	1.28 - 3.00 (2.00)
		Carp Su	32	-	-
		Red Su	1	-	-
		Carp	7	-	-
		SMB	2	-	-
		Drum	2	-	-
		GE	15	-	-
		YP	1	-	-
April 7-8 (1977)	5	SA	40	5.8 - 18.6 (10.8)	0.04 - 1.92 (0.44)
		Ling	36	15.1 - 34.1 (20.8)	0.91 - 7.70 (2.15)
		NP	2	25.0 - 28.7 (26.8)	3.80 - 5.50 (4.65)
		Carp	208	-	-
		Carp Su	20	-	-
		S. Cat.	4	-	-
		GE	28	-	-
		BMB	1	-	-
April 19-22 (1977)	5	SA	14	9.2 - 22.0 (15.0)	0.20 - 3.00 (1.08)
		NP	27	23.6 - 40.6 (31.5)	3.00 -15.90 (7.91)
		Ling	1	20.5	1.18
		WCR	1	8.9	0.34
		Drum	1	-	-
		BMB	1	-	-
		Carp Su	8	-	-
		Carp	7	-	-
		GE	9	-	-
		S. Cat	1	-	-
		Red Su	2	-	-

*Species Abbreviations: SA - Sauger; NP - Northern Pike; BMB - Bigmouth Buffalo; SMB - Smallmouth Buffalo; Carp Su - River Carpsucker; GE - Goldeye; BCR - Black Crappie; YP - Yellow Perch; WCR - White Crappie; S.Cat. - Stone cat; Red SW - Redhorse sucker; STUR - Shovelnose Sturgeon

Table 6. Summary of electrofishing data collected on streams during 1976.

Name of Stream	Length of Section	Date	Species*	No. of Fish	Length Range - Inches (Average)
Middle fork of Cottonwood Creek	400'	7-29-76	Ct	3	5.5 - 11.9 (7.9)
			Eb	8	6.2 - 8.8 (7.6)
T6N, R10E, S23			Sculpins	Numerous	
Middle Fork Cottonwood Creek	400'	7-29-76	Ct	1	3.8
			Eb	9	6.9 - 8.2 (7.5)
T6N, R10E, S12			LL	6	9.0 - 17.2 (15.4)
			Sculpins	Numerous	
West Fork Cottonwood Creek	400'	7-29-76	Eb	6	4.5 - 8.8 (7.0)
T6N, R10E, S11					
West Fork Cottonwood Creek	400'	7-29-76	Eb	9	5.6 - 7.8 (6.7)
T6N, R10E, S10					
McCartney Creek	400'	7-26-76	Eb	6	2.4 - 10.5 (5.1)
T13N, R20E, S24					
McCartney Creek	400'	7-26-76	Eb	37	3.9 - 11.5 (6.3)
T13N, R21E, S19			Sculpins	Numerous	

*Species Abbreviations: Ct - Cutthroat trout; Eb - Brook trout; LL - Brown trout; Sculpins - Mottled Sculpin.

Table 7. Summary of erosion which occurred at two transects located above and below the mouth of Burris Creek on the Lost Fork of the Judith River 1968-1977.

Location	1968	1971	1976	1977
Station #1 (Below Burris Cr.)	Transect Established	33[1/]	15.5	61
Station #2 (Above Burris Cr.)	Transect Established	143	108	96

1/ Figures given in cubic yards.

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Prepared By: Michiel Poore

Date: June 30, 1975

Code numbers of waters referred to in this report are:

16-0300	Big Spring Creek Sec. 01
16-0310	Big Spring Creek Sec. 02
16-2140	Lost Fork Judith River
16-2520	Missouri River Sec. 06
16-3920	Warm Spring Creek
16-4300	Ackley Lake
16-4950	East Fork Spring Creek Reservoir
16-7286	Norman Pond
16-7920	Rhoda Lake
17-9616	Smith River Reservoir
18-3750	McCartney Creek
18-3930	Middle Fork Cottonwood Creek
18-6540	West Fork Cottonwood Creek
18-7165	Bell Pond
18-7750	Bair Reservoir
18-8380	Martinsdale Reservoir
18-8720	Petrolia Reservoir
18-8840	Rindal Pond
18-9440	War Horse Reservoir
18-9500	Yellow Water Reservoir

MONTANA DEPARTMENT OF FISH AND GAME
ECOLOGICAL SERVICES DIVISION

JOB PROGRESS REPORT
RESEARCH PROJECT STATEMENT

State Montana Title Middle Missouri River

Project Number FW-3-R-5 Planning Project

Job Number 1-a Fisheries

Period Covered July 1, 1976 through June 30, 1977

ABSTRACT

Field inventory of the aquatic resources and factors influencing the resources will be the basis for an aquatic resource management plan for the middle Missouri River. The study area consists of a 184-mile reach of the mainstem of the river in northcentral Montana from Morony Dam to Robinson Bridge. The project was initiated October 1, 1975.

Fish populations were inventoried by boom shocking and experimental gill netting in eight study sections on the middle Missouri River from early March through late October 1976. A total of 31 species representing 14 families of fish was sampled during the inventory period. The annual migration of paddlefish from Fort Peck Reservoir into the Missouri River was monitored by electrofishing with the boom shocker during the spring of 1977. Most of the paddlefish counted during the migration period were observed in the lower reach of the Missouri River between Robinson Bridge and Fort Peck Reservoir, and the peak of the run occurred in about mid-May. Spawning migrations of shovelnose sturgeon and sauger within the Missouri River mainstem and migrations from the Missouri River into the lower Marias River were also monitored.

A paddlefish creel census study was conducted on a 15-mile reach of the Missouri River located immediately upstream from Fort Peck Reservoir during the annual spring migration period in 1977. An estimated 1,625 anglers fished 2,526 man-days and harvested 666 paddlefish. The estimated total weight of the 1977 paddlefish harvest was 35,195 pounds (17.6 tons). Total fishing pressure and total paddlefish harvest was higher in 1977 than during any of the previous years when creel censuses were conducted. Low water levels in the Missouri River during the snagging season in 1977 may have been partly responsible for the increased angler pressure and harvest. The average length and weight of paddlefish harvested in 1977, 61.0 inches and 55.6 pounds, was similar to the average size of fish harvested in previous years. Females accounted for 41.6 percent of the paddlefish examined in the 1977 harvest while males comprised 58.4 percent. Data on paddlefish tagging and angler residence are also presented.

Water temperature was monitored at three stations on the Missouri River during 1976. Water temperatures at the Coal Banks Landing and

Robinson Bridge stations during the periods of record for 1976 averaged only 0.4 and 0.3 F higher, respectively, than the Fort Benton station. Preliminary findings on the ordinal composition and longitudinal distribution of aquatic macroinvertebrates in the middle Missouri River are presented.

BACKGROUND

A basic inventory is essential in formulating management plans for maintaining and utilizing the fishery resources of a given area. Seldom is this information complete for an entire area or drainage. The middle Missouri River in Montana supports a significant fishery and basic inventory data on the aquatic resources of this area are lacking.

The aquatic resources of Montana are becoming increasingly threatened by an expanding population. Not only is more recreational use being placed on the resources, but human activities are encroaching on the aquatic habitat at an alarming rate. Man's activities on the floodplain, streambanks and headwaters have altered many of our streams beyond the point at which they can naturally adjust.

Because of the increasing human demand for Montana's limited water supplies for industrial, agricultural and domestic uses, the prospect for water resource development plans on streams such as the middle Missouri River in Montana appears likely. Projects which remove or impound substantial amounts of streamflow will undoubtedly alter the existing flow regimens and associated aquatic communities. Unless basic inventory data are collected and present and future problems are identified, little can be done to evaluate conflicting resource demands and minimize adverse impacts on the aquatic resource.

OBJECTIVES

The long-range objective of the study is to follow the inventory procedures developed on the Smith River (Wipperman 1973) and the upper Yellowstone-Shields River (Berg 1975) drainages to prepare recommendations for aquatic resource management on the middle Missouri River. Basic inventory data will be collected from the middle Missouri River to formulate the plan. Physical, chemical and biological characteristics of the waters of importance, or potential importance, to the recreational fishery of the study area will be determined. Immediate and future problems affecting the aquatic resource will be identified, and some recommendations to alleviate the problems will be proposed. The study was initiated on October 1, 1975.

DESCRIPTION OF THE STUDY AREA

The study area consists of a 184-mile reach of the mainstem of the middle Missouri River in northcentral Montana from Morony Dam near Great Falls, Montana to Fred Robinson Bridge near Landusky, Montana (Figure 1). The Missouri River forms at the confluence of the Gallatin, Jefferson, and Madison rivers near Three Forks in southwestern Montana. It drains the greater part of the eastern slopes of the Rocky Mountains in the state before entering the study area at Morony Dam.

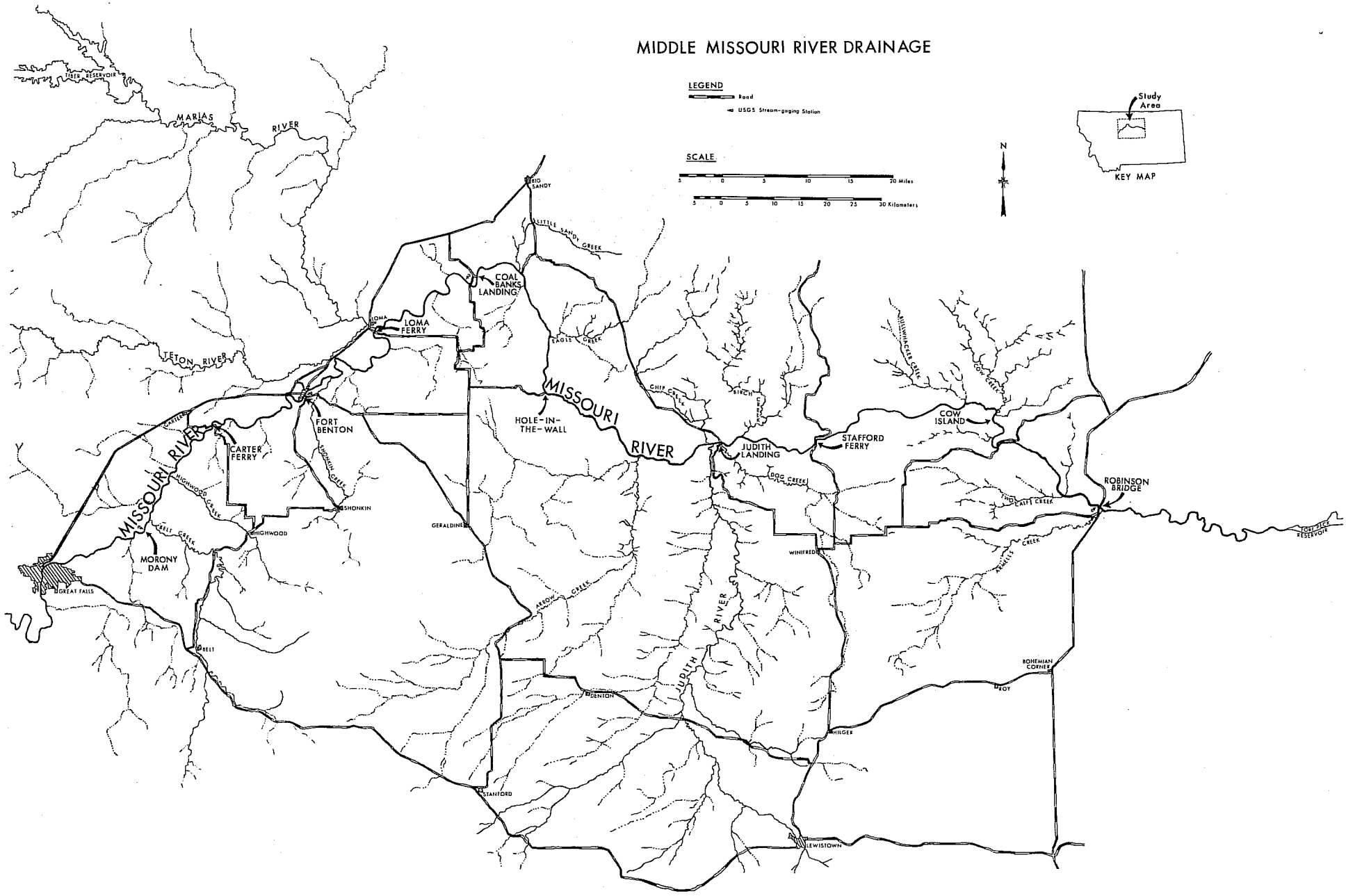

Figure 1. Map of middle Missouri River drainage in Montana.

The Missouri is the nation's longest river. The 184-mile reach covered by this study represents the last major free-flowing portion of the entire 2,475-mile-long river. From Three Forks to Great Falls, the Missouri is characterized by several dams and intensive bottomland cultivation. From Fort Peck to its junction with the Mississippi, the river has been heavily engineered with channel pilings, flood walls, dams and reservoirs which have impaired the river's natural values.

The land contiguous to the Missouri River in the study area has retained most of its primitive characteristics. It consists primarily of rolling plains, interrupted at considerable distances from the river by isolated areas of mountain uplift (Missouri River Joint Study 1963). The gorge-like river valley, which lies 500 to 1,000 feet below the average elevation of the adjacent upland plains, is comprised largely of spectacular, varied and highly scenic badlands and breaks areas ranging from 2 to 10 miles in width.

Because of its extraordinary historical, recreational, scenic and natural values, a 149-mile segment of the Missouri River in the study area from Fort Benton to Robinson Bridge has been designated as part of the National Wild and Scenic Rivers System (U. S. Congress 1975a). This inclusion, signed into law on October 13, 1976, affords considerable protection for the last major free-flowing portion of the Missouri River. Under provisions of the legislation, no dams may be built on any of the protected waters and specific protective regulations would be imposed on any new commercial development in designated areas surrounding the protected waters (U. S. Congress 1975b). The law does allow minor diversion and pumping of water from the protected area for agricultural uses. Private landowners in the area can continue with traditional grazing, farming, recreational and residential uses.

The Marias River from the north, including its tributary the Teton River, and the Judith River from the south are the principal tributaries entering the Missouri River in the study area. Other tributary drainages entering the Missouri River from the north in the study area include Little Sandy, Eagle, Chip, Birch, Bullwhacker and Cow creeks. Belt, Highwood, Shonkin, Arrow, Dog, Two Calf, and Armells creeks enter from the south.

TECHNIQUES AND EQUIPMENT DEVELOPMENT

Water Temperature

Thirty-day continuous recording thermographs were used to monitor water temperature regimes. The recorder box was positioned on the streambank as far above the high water mark as possible. A thermocouple lead, varying in length from 25 to 50 feet, was extended into the water through flexible plastic sewer pipe.

Macroinvertebrates

Aquatic macroinvertebrate samples were taken using a rectangular framed (8 x 18 inches), conical net kick sampler with fine mesh (300 micron) pores. The net was positioned on the streambottom so that the current

flowed into it. Macroinvertebrates were washed into the net by an operator standing in front of the net kicking downwards into the substrate. A variety of habitat types (cobble, gravel, sand, mud, submerged vegetation, etc.) were sampled at each station to obtain a representative sample. Samples were transferred to jars containing an identifying label and preserved with 10 percent formaldehyde.

In the laboratory, the samples were washed on a U. S. Series No. 30 screen. Material retained by the screen was transferred to an enamel sorting pan where the aquatic macroinvertebrates were separated from vegetation and bottom materials. Separation of macroinvertebrates was accomplished by picking each sample twice. Macroinvertebrates were identified to the lowest taxon practical using keys by Ward and Whipple (1959), Pennak (1953), Brown (1972) and Roemhild (1976).

Fish Populations

The middle Missouri River is a substantially larger stream than the Smith or upper Yellowstone River drainages where the previous inventory and planning investigations were conducted. The Missouri has a greater diversity of aquatic habitat types and a larger variety of fish species than the aforementioned drainages. Natural turbidity, deep water and deceptive current velocities present problems for survey operations in many areas.

Because of these problems, many of the fish population sampling procedures developed during the previous inventory and planning studies cannot be used on the Missouri River. A basic objective of this study is to become familiar with proven sampling methods on large rivers and develop sampling equipment and techniques adaptable to the Missouri River. The following fishery sampling gear and methods were tested and utilized during this report period. A continuing effort will be made to refine sampling techniques already in use and to develop new techniques.

Boom-Suspended Electrofishing Apparatus

Alternating or direct current shockers with electrodes suspended from fixed booms have been relatively successful for sampling fish populations in large rivers such as the lower Yellowstone River in Montana (Peterman and Haddix 1975), the Missouri River in Nebraska (Morris 1965 and Stuckey 1973), the Missouri River in Missouri (Robinson 1973 and 1977), and other large rivers (FAO 1975).

A boom shocker was constructed for use on the middle Missouri River during the report period. Basic design of the boom shocker was adapted largely from boom shockers used in Wisconsin (Novotny and Priegel 1974) with specific modifications similar to those used on the lower Yellowstone River in Montana (Peterman and Haddix 1975). Assistance in constructing the boom shocker was provided by Larry Peterman, Ecological Services Division, Montana Department of Fish and Game, Miles City.

The electrofishing apparatus was mounted on a 22-foot semi-vee aluminum boat powered by a 245-horsepower inboard jet. An aluminum boat offers the advantage of simple reliable grounding of all electrical equipment by the physical attachment of the equipment to the boat (Novotny and Priegel 1974). A metal railing was constructed around the front deck of the boat for safety and to facilitate collection of stunned fish with dip nets.

The electrode system of this boat consists of positive and negative arrays. Since the boat was intended primarily for operation with direct current, the electrode configurations were designed specifically for this operating mode. However, the electrode system is also adequate for operation in the alternating current mode.

The positive electrode system consists of two anodes suspended from fiberglass booms approximately 6 feet ahead of the bow of the boat. The booms are spread 7 feet apart and are adjustable for height by means of pin-locked adjustments. Each anode consists of either (1) a spherical electrode, 15 inches in diameter, constructed from 3/8-inch diameter copper tubing; or (2) an array of 12 to 15 "dropper" electrodes clipped to a 3-foot diameter aluminum support ring. The support ring provides mechanical support and an electrical connection for the droppers which actually carry the current into the water. Individual "droppers" consist of 6-inch lengths of 5/8-inch diameter stainless steel tubing supported by an 18-inch length of heavy gauge insulated copper wire with a 20 amp test clip to attach to the support ring. By moving a sleeve of insulating material (5/8-inch diameter auto wire loom) exposure of the stainless steel "droppers" can be adjusted for waters of varying conductivity.

The negative electrode system consists of two cathode arrays, one mounted on each side of the boat. Each array consists of a set of five 4-foot lengths of 3/4-inch diameter flexible conduit supported by an 8-foot length of fiberglass boom. Each length of conduit is fastened to the support boom by a chain and rubber insulator. The top of each length of conduit is insulated with electrical tape to reduce an unnecessary electrical field near the surface of the water.

Power is supplied to the positive and negative electrodes through 1/2-inch diamater metal conduit and watertight junction boxes. Industrial duty electronic plugs and receptacles (screw-in type) provide positive watertight connections between junction boxes, electrodes and power source.

The power source for the electrofishing system is a 2,500 watt, 230 volt (60 Hz. single phase) alternating current generator. A Coffelt Model VVP-15 rectifying unit is used to change the alternating current to various forms of pulsed or continuous direct or alternating current. Output from the rectifying unit is selectable from 0 to 600 volts and from 0 to 25 amps. Pulse frequency is adjustable from 20 to 200 pulses per second and pulse width is adjustable from 20 to 80 percent. Meters are used to monitor all voltages, current output, frequency and pulse width.

Most of the aquatic habitat of the Missouri River in the study area consists of deep mainstem areas with a few large side channels and backwaters. The boom suspended electrofishing apparatus was the most effective technique for sampling these areas. Other procedures such as mobile electrofishing apparatus, gill nets, hoop nets, frame traps and seining were primarily effective only in restricted habitat areas such as shorelines, quiet pools, backwaters and small side channels.

Mobile Electrofishing Apparatus

A mobile electrode apparatus was used for sampling fish populations in the lower Marias River and in shallow, restricted side channel and backwater areas of the Missouri River. Maneuverability of the relatively small mobile unit in these confined habitat areas proved to be highly advantageous.

The mobile electrofishing unit consists of a 14-foot fiberglass boat containing a hand-held mobile positive electrode, a stationary negative electrode (fastened to the bottom of the boat) and a portable 2,500-watt, 115 volt (60 Hz. single phase) alternating current generator. A Fisher Model FS-103 rectifying unit is used to change the alternating current to various forms of pulsed or continuous direct current. The direct current output is adjustable from 0 to 500 volts. A 40-horsepower jet outboard was used for mobility in deep water areas where the electrofishing boat could not be maneuvered by hand.

Gill Nets

Fish were also captured with standard experimental sinking nylon gill nets (125 x 6-foot with graduated mesh size from 3/4 to 2-inch square measure). Overnight stationary sets with these nets in areas of the river with little or no current generally produced good catches of a wide variety of fish species. Stationary gill net sets in areas of the river with any significant amount of current were largely unsuccessful because the nets usually became badly fouled with debris and, in some cases, were washed downstream by the current.

In some main channel areas of the Missouri River with moderate current, heavy duty large mesh sinking nylon gill nets were drifted perpendicular to the current in an attempt to capture fish. These nets were 8-feet deep and varied in length from 50 to 150 feet. The nets could be drifted only in areas of the river relatively free from snags and with sufficient current to carry the nets. In many areas the current was too swift for drifting the nets.

Drifting gill nets with 3-inch square measure mesh was effective and fairly selective for sampling shovelnose sturgeon and blue suckers. Paddlefish were taken readily by drifting gill nets with 5-inch square measure mesh in the Missouri River below Robinson Bridge. The 5-inch mesh appeared to be exclusively selective for paddlefish.

Frame Traps

Spawning migrations of sauger and other species were followed on the lower Marias River and on the Missouri River in the Loma Ferry and Fort Benton sections with 3-foot high by 4-foot long frame traps. The traps were constructed from 1-inch square mesh fence wire and 1/2-inch diameter reinforcing rod material. Similar traps had been used successfully by Posewitz (1963) to capture fish in the middle Missouri River and the lower reaches of its tributaries.

The frame traps were set in the river with the open throat facing downstream. One or two lead nets, 3 to 6 feet high, with 1-inch square mesh and from 10 to 50 feet long, were stretched at various angles downstream from the trap. The angle depended on the force of the current at the trap site.

The frame traps were successful for sampling a substantial number of migrating adult game fish, especially sauger, during their spawning seasons. Posewitz (1962) believed the traps were selective for sauger in the lower Marias River. Selectivity toward adult fish was probably due to the relatively large 1-inch square mesh size of the traps and leads. Ricker (1971) reported that underwater frame traps are selective by species, and have been selective for the larger fish of a size class above the minimum imposed by the physical dimensions of the net (mesh). Traps and leads of a mesh size smaller than 1 inch cannot be fished effectively in the Missouri River because they impede streamflow, trap debris and are washed out much more easily than the large mesh.

Seines

Fifty and 25 x 4-foot nylon bag seines with 1/4 and 1/8-inch square mesh were used to collect forage fish samples. Most of the seining sites were in confined areas of the river, such as backwaters and side channels, where the presence of forage fish was considered to be likely. Some forage fish were also taken in selected unconfined portions of the open river, such as shoreline and shallow riffle areas.

Fish Sample Processing and Tagging

Fish captured by the various techniques were anesthetized with MS-222, measured to the nearest 0.1 inch in total length, and weighed to the nearest 0.01 pound. In addition, paddlefish and shovelnose sturgeon were also measured to the nearest 0.1 inch in fork length. Sex and spawning condition (gravid, ripe or spawned) were recorded for fish captured during their spawning season. All fish were released near the capture site.

In addition to the above, a number of fish species was marked with individually numbered tags. Tag return data will be used to provide an indication of fisherman harvest rates and to determine movement patterns of individual fish, particularly spawners, and establish their home ranges.

Individually numbered plastic cinch-up spaghetti tags anchored through the base of the adipose fin were used to mark channel catfish. Shovelnose sturgeon were tagged with individually numbered monel wing band tags clipped over the anterior rays of the pectoral fin or with individually numbered plastic cinch-up spaghetti tags inserted through the posterior portion of the fleshy keel at the base of the dorsal fin. All other game fish species and several nongame species, including blue suckers, bigmouth buffalo, smallmouth buffalo and freshwater drum were tagged with individually numbered Floy T-tags inserted near the base of the dorsal fin. Information signs were placed at accessible points along the river in the study area in an effort to encourage anglers to provide information about tagged fish in their creel.

Creel Census and Fisherman Survey

Paddlefish Creel Census

A creel census study was conducted on the paddlefish fishery on the Missouri River immediately upstream from Fort Peck Reservoir during the spring of 1977. The creel census method was adapted largely from Needham (1973). Based on field tests of various creel census methods, Needham selected this technique because it was the most reliable one for the Missouri River study area.

Creel census data was collected on as many days as possible throughout the entire spring paddlefish snagging season. Weekend days and holidays received much heavier fishing pressure than week days. Therefore, a larger proportion of weekend-holiday days were creel censused than week days. Estimates of fisherman pressure and catch on noncensus days were based on data from preceding and following census days. In addition, some information on pressure and harvest on noncensus days was provided by U. S. Fish and Wildlife Service personnel stationed on the Charles M. Russell National Wildlife Range which borders the study area and by game wardens from the Montana Department of Fish and Game.

As many fishermen as possible were interviewed on completion of their fishing day. On most days the absolute number of fishermen and their harvest could be determined. Data recorded on angler interviews included angler residency, length of trip, estimated time spent fishing, method of fishing (bank or boat), number of paddlefish caught and number of paddlefish kept.

As many of the anglers' fish as practical were measured to the nearest 0.5 inch in total length, fork length and eye-fork length. Weights were determined to the nearest 1.0 pound with a Chatillon Model 100A straight spring scale. Sex was determined by weight, body configuration, presence of tubercles and examination of the gonads and urogenital pore.

Dentary bones were taken from a number of paddlefish for age determination. Ages will be estimated from cross sections of the dentary bone prepared in the manner described by Adams (1942).

A number of paddlefish in good condition caught by fishermen who did not wish to keep them were tagged and released near the capture site. The tags used were individually numbered monel poultry bands anchored around the dentary bone near its symphysis. Tag returns will provide information on fisherman harvest rates and movements.

Missouri River Fisherman Survey

A fisherman creel survey was initiated in the spring of 1977 on the sport fishery which exists on the Missouri River from Great Falls to Fort Peck Reservoir. This survey is a partial census in which samples (i.e., interviews) of fishermen are used to obtain estimates of angling data. The survey technique, formulated with the assistance of George Holton, Fisheries Division, Montana Department of Fish and Game, utilizes a fish species identification chart and postcard-sized fisherman survey forms (Appendix Figures 1 and 2).

The fisherman survey forms are of two different types - "voluntary" and "interview." The "voluntary" survey form relies on voluntary compliance in answering the survey and returning the postpaid card. "Voluntary" forms are distributed to parties of fishermen by personnel from the Bureau of Land Management (Lewistown) and Northwestern University (Chicago, Illinois) during the course of their recreational use surveys on the river.

With the "interview" survey form, partial trip data is obtained during interviews with individual fishermen. The "interview" form is recorded in duplicate, with the original copy retained by the census taker and the carbon copy given to the fisherman. Upon completion of his fishing trip, the fisherman voluntarily records complete trip data and returns the postpaid carbon copy of the "interview" form. As many interviews as possible are obtained during the course of our research activities, such as electrofishing and gill netting on the river. In addition, a number of days, especially weekend days and holidays, were devoted exclusively to collecting fisherman survey data. Weekend days and holidays normally receive much heavier fishing pressure than week days.

Data recorded on the fisherman survey forms include angler residency, party size, length of trip, estimated time spent fishing, type of fishing (bank or boat), method of fishing (setline, angling or snagging), type of lure used and number and kind of fish kept and released.

AQUATIC HABITAT PARAMETERS

Drainage Area and Stream Discharge

The drainage area of the middle Missouri River increases from 23,292 square miles to 40,987 square miles, or by about 75 percent, between Morony Dam and Robinson Bridge (USGS 1974). However, due to the semi-arid nature of the area's climate, the increase in mean annual streamflow is only about 18 percent. The climate is characterized by moderately low rainfall, a dry atmosphere, hot summers, cold winters and a large proportion of sunny days (Gieseker 1931). Precipitation averages about 13 inches annually, of which about 8.5 inches occurs during the months of May through September (Missouri River Joint Study 1963).

Streamflow regimens are being monitored by the U. S. Geological Survey at four locations on the mainstem of the middle Missouri River. The stations are located at Morony Dam, Fort Benton, Coal Banks Landing and Robinson Bridge. Mean annual discharges for an 18-year period of record at Morony Dam, an 84-year period of record at Fort Benton, a 39-year period of record at Coal Banks Landing and a 40-year period of record at Robinson Bridge were 5.569 million acre feet (MAF) (7,687 cfs), 5.572 MAF (7,691 cfs), 6.079 MAF (8,391 cfs), and 6.593 MAF (9,100 cfs), respectively (USGS 1974). The maximum flows recorded at the four stations, respectively, were 72,000 cfs (June 10, 1964), 140,000 cfs (June 6, 1908), 122,000 cfs (June 5, 1953) and 137,000 cfs (June 6, 1953). The recorded minimums were 1 cfs (Sept. 16, 1962, powerplant shutdown) at Morony Dam, 627 cfs (July 5, 1936) at Fort Benton, 638 cfs (July 5, 1936) at Coal Banks Landing and 1,120 cfs (July 8, 1936) at Robinson Bridge. The present day flow regimens are not entirely natural because of regulation and storage at several dams in the drainage upstream from the study area.

Stream Gradient and Velocity

The Missouri River enters the study area immediately below Morony Dam at an elevation of 2,809 feet msl, dropping 550 feet to an elevation of 2,259 feet msl at Robinson Bridge. Stream gradient averages 2.99 ft/mile and varies from over 10 ft/mile in the extreme upper reaches to less than 2 ft/mile in some sections (Table 1). A longitudinal profile of the Missouri River from Morony Dam to Fort Peck Reservoir is shown in Figure 2. Stream gradients were determined by measurements taken from U. S. Geological Survey topographic maps (1:24,000 scale). A river mileage chart for the middle Missouri, also taken from the topographic maps, is presented in Appendix Table 1.

Velocity of the middle Missouri River is closely associated with stream width, discharge and gradient. Mean velocities vary from about 3.5 to 2.0 feet per second at a discharge of 6000 cubic feet per second (USDI 1975).

Water Temperature

Water temperatures are being monitored during the ice-free period by continuous recording thermograph stations located on the Missouri River at Fort Benton, Coal Banks Landing and Robinson Bridge. The 5 day average maximum and minimum water temperatures during 1976 at the three stations are shown in Appendix Figures 3, 4 and 5, respectively. The Coal Banks Landing Station is operated by the U. S. Geological Survey and the others are maintained by the Department of Fish and Game.

At the Fort Benton station during 1976, water temperature warmed progressively from late April through early June (Appendix Figure 3). The average maximum water temperature increased from 46 degrees to 60 degrees during this time period. Water temperature was stabilized during June with the average maximum temperature in the lower 60 degrees range. Another warming trend occurred from early July through early August when the average maximum water temperature rose from 61 degrees to 74 degrees. The highest annual water temperatures at the Fort Benton station were achieved during late July and early August. During the period from July 16 to August 11, water temperatures reached 73 degrees

Table 1. Stream gradients of the middle Missouri River from Morony Dam to Fort Peck Lake. Confluence of the Missouri River with the normal pool of Fort Peck Lake is mile 0.0.

River Mile	Elevation (feet)	Gradient (ft/mile)
207.0 (Morony Dam)	2809	
206.3	2800	16.41
205.2	2780	18.69
203.1	2760	9.34
201.2	2740	10.81
196.5	2720	4.19
192.2	2700	4.66
189.1	2680	6.41
185.0	2660	4.88
179.9	2640	3.95
175.4	2620	4.45
168.4	2600	2.84
162.5	2580	3.41
158.4	2560	4.88
149.4	2540	2.20
140.0	2520	2.13
126.6	2500	1.49
117.3	2480	2.13
107.5	2460	2.05
98.7	2440	2.30
92.1	2420	3.01
83.0	2400	2.20
70.4	2360	3.17
56.3	2320	2.82
40.8	2280	2.59
23.2 (Robinson Bridge)	2259	2.08
0.0 (Fort Peck Lake)	2246	0.83

or higher on 22 days. The highest temperature recorded at the Fort Benton station during 1976 was 75 degrees on July 25 and 26. Temperatures cooled gradually from mid-August through December.

At the Coal Banks Landing and Robinson Bridge stations during 1976, shorter periods of record were available than for the Fort Benton station. However, seasonal trends of average maximum-minimum water temperatures as presented in Appendix Figures 4 and 5 are similar to those previously described for the Fort Benton station. The highest water temperature recorded at the Coal Banks Landing and Robinson Bridge stations during 1976 was 76 degrees. This temperature was achieved on July 26 at Coal Banks Landing and on July 25 and 26 at Robinson Bridge. Water temperature at the Coal Banks Landing and Robinson Bridge stations during the periods of record for 1976 averaged only 0.4 and 0.3 degrees higher, respectively, than the Fort Benton station. The mean diurnal differences between the average maximum and average minimum temperatures were 4.53, 4.07 and 2.26 degrees for the Fort Benton, Coal Banks Landing and Robinson Bridge stations, respectively.

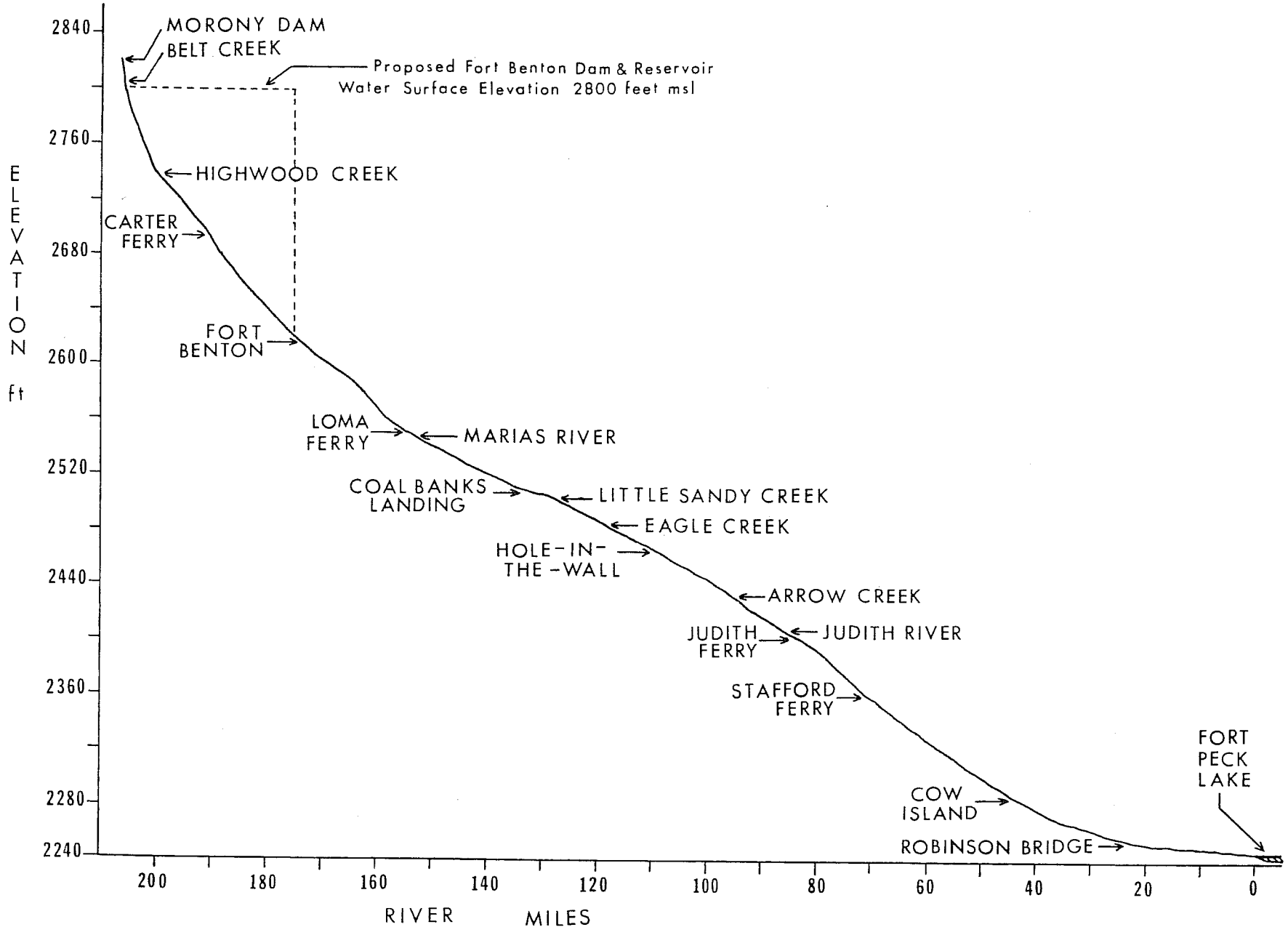

Figure 2. Longitudinal profile of the Missouri River from Morony Dam to Fort Peck Reservoir.

MACROINVERTEBRATES

Aquatic macroinvertebrate sampling was initiated at five study stations on the middle Missouri River beginning in late October 1976. The stations are located at Morony Dam, Fort Benton, Coal Banks Landing, Judith Landing and Robinson Bridge (Figure 1). Samples have been taken at approximately 6-week intervals. Findings contained in this progress report are based on analyses of samples taken in late October, early December, late January and mid-March 1976-77. Findings presented at this time are not necessarily final and may be subject to change because additional samples are presently being gathered and analyzed.

A total of 20,261 macroinvertebrates representing 15 orders was collected during the four sampling periods. The number of macroinvertebrates per individual kick sample ranged from 62 to 6,901. The ordinal composition for each station with each sampling date weighted equally and for all stations combined is given in Table 2. Diptera, Ephemeroptera, Trichoptera and Plecoptera comprised 45, 27, 18 and 2 percent of the macroinvertebrates collected, respectively. The orders Ephemeroptera, Trichoptera, Diptera, and Plecoptera contained representatives of 6, 4, 4 and 3 families, respectively.

Table 2. Preliminary findings on the percent composition (by order) of the aquatic macroinvertebrate community in the middle Missouri River, late October through mid-March 1976-77.

	Station					
Order	Morony Dam	Fort Benton	Coal Banks Landing	Judith Landing	Robinson Bridge	Combined Average
Ephemeroptera	25	22	15	40	31	27
Plecoptera	0	<1	<1	7	5	2
Trichoptera	33	19	6	16	14	18
Diptera	39	53	66	32	38	45
Others	3	6	13	5	12	8

The longitudinal distribution of aquatic macroinvertebrates throughout the study area is presented in Table 3. The families Heptageniidae, Baetidae, Hydropsychidae and Chironomidae were sampled regularly at all the stations. In addition, the families Ephemerellidae, Perlodidae, Corixidae, and Dytiscidae were sampled regularly at all the stations except Morony Dam.

Table 3. Preliminary findings on the longitudinal distribution of aquatic macroinvertebrates in the middle Missouri River, late October through mid-March 1976-77.

Taxa	Station				
	Morony Dam	Fort Benton	Coal Banks Landing	Judith Landing	Robinson Bridge
Gordiida	*	*			
Oligocheata	*	*	*	*	*
Decapoda					
Astacidae *Orconectes*	*				
Ephemeroptera					
Leptophlebiidae *Leptophlebia*					*
Siphlonuridae *Ameletus*					*
Parameletus					*
Tricorythidae *Tricorythodes*	*	*		*	*
Ephemerellidae *Ephemerella*		*	*	*	*
Heptageniidae *Rhithrogena*		*	*	*	*
Stenonema	*	*	*	*	*
Cinygma		*	*	*	*
Baetidae *Baetis*	*	*	*	*	*
Pseudocloeon	*		*	*	
Centroptilum			*		
Odonata					
Gomphidae *Octogomphus*					*
Plecoptera					
Nemouridae *Brachyptera*			*		*
Capnia				*	*
Perlidae *Acroneuria*		*		*	*
Perlodidae *Acrynopteryx*		*	*	*	*
Isoperla		*	*	*	*
Heteroptera[1/]					
Corixidae *Trichocorixa*		*			*
Hesperocorixa		*			
Sigara		*	*	*	*
Coleoptera					
Haliplidae *Haliplus*		*			
Dytiscidae *Hydrovatus*				*	*
Hydroporus		*	*		
Dytiscus		*			
Elmidae *Optioservus*	*	*			

Table 3. Preliminary findings on the longitudinal distribution of aquatic macroinvertebrates in the middle Missouri River, late October through mid-March 1976-77. (continued)

Taxa	Station				
	Morony Dam	Fort Benton	Coal Banks Landing	Judith Landing	Robinson Bridge
Trichoptera					
Hydropsychidae *Hydropsyche*	*	*	*	*	
Cheumatopsyche	*	*	*	*	*
Hydroptilidae *Agraylea*	*	*	*		
Leptoceridae *Oecetis*	*	*	*	*	
Brachycentridae *Brachycentrus*		*		*	*
Lepidoptera					
Pyralidae *Cataclysta*	*	*			
Diptera					
Tipulidae *Hextoma*	*				
Chironomidae	*	*	*	*	*
Simuliidae *Simulium*		*	*	*	
Empididae		*			
Acari					
Eylaidae *Eylais*		*			
Pulmonata					
Ancylidae *Ferrissia*		*			
Total Number of Taxa	15	29	19	20	22

1/ Formerly Hemiptera

Kick samples of aquatic macroinvertebrates at 6-week intervals will be continued at the five previously mentioned stations on the mainstem of the Missouri River until one full year of data is obtained in the fall of 1977. Seasonal kick sampling of macroinvertebrate communities will be initiated on the lower reaches of the Marias and Judith Rivers. In addition, macroinvertebrate sampling with a Petersen dredge and artificial substrates will be initiated during 1977 at the five stations on the mainstem of the Missouri River to ensure that the longitudinal distribution of a majority of the aquatic macroinvertebrates can be determined.

FISH POPULATIONS

Species Distribution, Relative Abundance and Size Composition

Forty-nine species representing 14 families of fish are known to occur in the middle Missouri River drainage between Morony and Fort Peck Dams (Table 4). Thirty-five species are found in the mainstem of the Missouri River in the present study area from Morony Dam to Robinson Bridge. Known distribution of the remaining 14 species is limited to Fort Peck Reservoir or tributaries to the middle Missouri River. However, it is likely that most of the latter species occur at least as transients in the mainstem study area. Additional species will probably be added to the list during the course of the present investigation.

Fish populations were inventoried by boom shocking and experimental gill netting in eight study sections on the middle Missouri River from early March through late October 1976. A total of 4,418 fish representing 31 species was sampled during the inventory period. The primary objective of the surveys was to determine species distribution, relative abundance and size composition of fish populations in the study area. The study sections were located at Morony Dam, Carter Ferry, Fort Benton, Loma Ferry, Coal Banks Landing, Judith Landing, Cow Island and Robinson Bridge (Figure 1).

Longitudinal distribution of fish species sampled during 1976 is shown in Table 5. Walleye, sauger, burbot, white sucker, longnose sucker, shorthead redhorse, river carpsucker, carp and goldeye were the most cosmopolitan fish species, each occurring throughout the entire 184-mile length of the study area. Mountain whitefish, rainbow trout, brown trout, mountain suckers and mottled sculpin were most abundant in the upstream study sections with only an occasional specimen found in the lower reaches. Shovelnose sturgeon, flathead chubs, emerald shiners, silvery minnows, blue suckers, smallmouth buffalo, bigmouth buffalo, channel catfish and freshwater drum were common in the Missouri River below the confluence of the Marias River. Only an occasional transient specimen was sampled in the Missouri River upstream from the Marias River. Paddlefish were found seasonally in the Missouri River, particularly in the lower reaches of the study area. They occurred primarily during the spring when they migrate upstream from Fort Peck Reservoir into the Missouri River presumably to spawn, but occasional specimens were also observed in the summer and fall.

Catch rate summaries for electrofishing and gill net surveys conducted during 1976 are presented in Tables 6 and 7, respectively. The catch rate summaries provide an indication of species composition in each study section and allow for a general comparison of relative abundance of fish populations between study sections. Total catch, average size and size range for individual species sampled in each study section are shown in Appendix Tables 2 through 14.

Life History Studies

In addition to determining their longitudinal distribution, size composition and relative abundance, research is being conducted to define some of the basic life history requirements of common or important fish species in the study area, especially game fish.

Table 4. Fish species recorded for the middle Missouri River drainage in Montana between Morony and Fort Peck Dams (family, scientific, and common names).

ACIPENSERIDAE (Sturgeon family)
Scaphirhynchus albus - Pallid sturgeon
Scaphirhynchus platorynchus - Shovelnose sturgeon

POLYODONTIDAE (Paddlefish family)
Polyodon spathula - Paddlefish

HIODONTIDAE (Mooneye family)
Hiodon alosoides - Goldeye

SALMONIDAE (Trout family)
Prosopium williamsoni - Mountain whitefish
Onocorhynchus kisutch - Coho salmon*
Onocorhynchus nerka - Kokanee*
Salmo clarkii - Cutthroat trout*
Salmo gairdneri - Rainbow trout
Salmo trutta - Brown trout
Salvelinus fontinalis - Brook trout
Salvelinus namaycush - Lake trout*

ESOCIDAE (Pike family)
Esox lucius - Northern pike

CYPRINIDAE (Minnow family)
Cyprinus carpio - Carp
Carassius auratus - Goldfish
Notemigonus crysoleucas - Golden shiner*
Phoxinus eos - Northern redbelly dace*
Phoxinus neogaeus - Finescale dace*
Hybopsis gracilis - Flathead chub
Couesius plumbeus - Lake chub*
Notropis atherinoides - Emerald shiner
Hybognathus hankinsoni - Brassy minnow
Hybognathus placitus - Plains minnow*
Hybognathus nuchalis - Silvery minnow*
Pimephales promelas - Fathead minnow
Rhinichthys cataractae - Longnose dace

CATOSTOMIDAE (Sucker family)
Carpoides carpio - River carpsucker
Cycleptus elongatus - Blue sucker
Ictiobus bubalus - Smallmouth buffalo
Ictiobus cyprinellus - Bigmouth buffalo
Moxostoma macrolepidotum - Shorthead redhorse
Catostomus catostomus - Longnose sucker
Catostomus commersoni - White sucker
Catostomus platyrhynchus - Mountain sucker

Table 4. Fish species recorded for the middle Missouri River drainage in Montana between Morony and Fort Peck Dams (family, scientific, and common names). (Continued)

ICTALURIDAE (Catfish family)
Ictalurus melas - Black bullhead
Ictalurus punctatus - Channel catfish
Noturus flavus - Stonecat

GADIDAE (Codfish family)
Lota lota - Burbot

GASTEROSTEIDAE (Stickleback family)
Culaea inconstans - Brook stickleback*

CENTRARCHIDAE (Sunfish family)
Lepomis macrochirus - Bluegill*
Micropterus salmoides - Largemouth bass*
Pomoxis annularis - White crappie
Pomoxis nigromaculatus - Black crappie*

PERCIDAE (Perch family)
Perca flavescens - Yellow perch
Stizostedion canadense - Sauger
Stizostedion vitreum - Walleye
Etheostoma exile - Iowa darter*

SCIAENIDAE (Drum family)
Aplodinotus grunniens - Freshwater drum

COTTIDAE (Sculpin family)
Cottus bairdi - Mottled sculpin

* Known distribution is limited to Fort Peck Reservoir or tributaries to the middle Missouri River.

Table 5. Longitudinal distribution of fish species sampled in the middle Missouri River during 1976.

Fish Species	Study Section							
	Morony Dam	Carter Ferry	Fort Benton	Loma Ferry	Coal Banks Landing	Judith Landing	Cow Island	Robinson Bridge
Shovelnose sturgeon			*	*	*	*	*	*
Paddlefish					*			*
Goldeye	*	*	*	*	*	*	*	*
Mountain whitefish	*	*	*		*			
Rainbow trout	*					*		
Brown trout	*		*					
Northern pike	*			*				
Carp	*	*	*	*	*	*	*	*
Flathead chub			*	*	*	*	*	*
Emerald shiner				*	*	*		*
Silvery minnow					*		*	
Fathead minnow							*	
Longnose dace			*		*	*		
River carpsucker	*	*	*	*	*	*	*	*
Blue sucker			*	*	*	*	*	*
Smallmouth buffalo			*	*	*	*	*	*
Bigmouth buffalo			*	*			*	*
Shorthead redhorse	*	*	*	*	*	*	*	*
Longnose sucker	*	*	*	*	*	*	*	*
White sucker	*		*	*	*	*		*
Mountain sucker	*		*		*			
Black bullhead				*				
Channel catfish					*	*		*
Stonecat			*	*	*	*		
Burbot	*	*	*	*	*	*	*	*

Table 5 continued. Longitudinal distribution of fish species sampled in the middle Missouri River during 1976.

Fish Species	Study Section							
	Morony Dam	Carter Ferry	Fort Benton	Loma Ferry	Coal Banks Landing	Judith Landing	Cow Island	Robinson Bridge
White crappie					*	*		*
Yellow perch				*	*			
Sauger	*	*	*	*	*	*	*	*
Walleye	*		*	*	*	*		*
Freshwater drum			*	*	*	*	*	*
Mottled sculpin	*	*	*					
Total Number of Species	15	9	21	20	24	20	15	19

Table 6. Catch rate summary for electrofishing surveys on the middle Missouri River in 1976, expressed as number of fish sampled per electrofishing hour.

Fish Species	Study Section							
	Morony Dam	Carter Ferry	Fort Benton	Loma Ferry	Coal Banks Landing	Judith Landing	Cow Island	Robinson Bridge
Shovelnose sturgeon			0.1	1.1	1.1	0.4	1.0	0.8
Goldeye	17.5	20.1	8.8	16.5	25.5	16.1	19.8	11.4
Mountain whitefish	0.8	0.5	tr[1/]	-	0.1	-	-	-
Rainbow trout	0.2	-	-	-	-	tr	-	-
Brown trout	0.2	-	tr	-	-	-	-	-
Northern pike	0.2	-	-	0.2	-	-	-	-
Carp	2.5	1.3	4.0	4.7	8.5	4.6	11.5	3.3
Flathead chub	-	-	0.6	5.9	1.5	1.4	1.7	2.9
Emerald shiner	-	-	-	1.5	-	0.3	-	0.7
Longnose dace	-	-	0.5	-	-	-	-	-
River carpsucker	2.5	1.3	1.1	3.9	3.2	4.8	2.0	1.4
Blue sucker	-	-	0.2	0.2	0.6	0.4	3.2	0.7
Smallmouth buffalo	-	-	0.2	1.1	0.8	1.3	1.2	0.1
Bigmouth buffalo	-	-	0.1	0.2	-	-	0.2	0.1
Shorthead redhorse	15.0	18.0	23.6	18.8	28.8	19.3	6.2	2.6
Longnose sucker	15.0	30.0	12.9	18.9	9.8	4.5	0.2	0.2
White sucker	5.0	-	1.0	0.5	0.3	0.9	-	0.1
Mountain sucker	0.5	-	0.2	-	0.1	-	-	-
Channel catfish	-	-	-	-	-	0.5	-	0.1
Stonecat	-	-	tr	-	0.1	0.1	-	-
Burbot	0.8	0.5	tr	0.2	0.2	0.3	0.2	0.1
White crappie	-	-	-	-	-	0.1	-	0.1
Yellow perch	-	-	-	0.4	-	-	-	-
Sauger	9.3	7.5	9.4	7.3	4.9	7.1	2.5	5.1
Walleye	0.2	-	0.1	0.6	-	tr	-	0.1
Freshwater drum	-	-	0.5	0.9	0.3	0.4	0.5	0.3
Mottled Sculpin	0.2	0.3	0.4	-	-	tr	-	-
Total	69.9	79.5	63.7	82.9	85.8	62.5	50.2	30.1

1/ tr - trace (less than 0.05 fish/electrofishing hour)

Table 7. Catch rate summary for experimental gill net surveys on the middle Missouri River in 1976, expressed as number of fish captured per overnight net set.

Fish Species	Study Section				
	Fort Benton (8) [1/]	Loma Ferry (7)	Coal Banks Landing (5)	Judith Landing (1)	Robinson Bridge (1)
Shovelnose sturgeon	0.38	6.71	-	-	-
Goldeye	11.00	40.14	16.60	2.00	3.00
Mountain whitefish	-	-	-	-	-
Rainbow trout	-	-	-	-	-
Brown trout	0.13	-	-	-	-
Northern pike	-	-	-	-	-
Carp	2.13	1.14	0.20	-	-
Flathead minnow	0.63	0.57	0.20	-	2.00
River carpsucker	0.75	2.00	0.20	-	-
Blue sucker	0.63	-	-	-	-
Smallmouth buffalo	0.25	0.29	-	-	-
Bigmouth buffalo	0.50	-	-	-	-
Shorthead redhorse	2.63	1.86	3.60	-	1.00
Longnose sucker	5.25	2.57	0.80	-	-
White sucker	0.63	0.14	1.00	1.00	1.00
Mountain sucker	0.38	-	-	-	-
Black bullhead	-	0.29	-	-	-
Channel catfish	-	-	0.40	-	-
Stonecat	0.25	0.14	0.20	-	-
Burbot	0.25	-	-	-	-
White crappie	-	-	0.20	4.00	1.00
Yellow perch	-	-	0.20	-	-
Sauger	2.63	2.00	11.60	3.00	10.00
Walleye	0.13	-	0.20	-	1.00
Freshwater drum	1.63	0.29	-	-	-
Total	30.18	58.14	35.40	10.00	19.00

1/ Number of net sets.

During the spring of 1977 research efforts were directed primarily toward identifying and monitoring spawning migrations of sauger, shovelnose sturgeon and paddlefish. Migrations of these species within the Missouri River mainstem and migrations from the Missouri River into the lower Marias River were identified and monitored.

Paddlefish

Paddlefish are native to Montana and are found in both the Yellowstone and Missouri River drainages. Their presence in the state was first documented in the lower Yellowstone River in the early 1900's (Elser 1976). Today, significant numbers of paddlefish are found seasonally in the lower Yellowstone River and in the Missouri River in the dredge cut complex below Fort Peck Dam. Another paddlefish population inhabits the middle and upper portions of Fort Peck Reservoir. A portion of this population seasonally migrates upstream from Fort Peck Reservoir into the present study area on the middle Missouri River presumably to spawn.

The paddlefish was formerly abundant throughout much of the Mississippi-Missouri River system but has undergone a drastic decline since 1900 (Pflieger 1975, Rehwinkel 1975 and Vasetskiy 1971). A combination of destructive influences, including overharvest and loss of habitat in some areas, have contributed to this decline. Only seven known spawning populations of paddlefish exist today (Rehwinkel 1975). One of these populations occurs in the middle Missouri River and Fort Peck Reservoir.

The annual migration of paddlefish from Fort Peck Reservoir into the Missouri River was studied during 1977. The main objective of the study was to monitor the migration to determine timing of the run, relative abundance of paddlefish involved in the run and the extent (i.e., distance) of their upstream movements in the Missouri River.

The migration was monitored by electrofishing with the boom shocker. A direct current of 6 to 8 amps and 120 to 150 volts pulsed at 120 to 160 pulses per second with a pulse width of 40 to 50 percent was sufficient to make census counts of paddlefish involved in the run. A direct current of 8 to 10 amps and 150 to 200 volts pulsed at the same frequency and width was required to stun the paddlefish sufficiently to capture them in dip nets.

A total of 12 electrofishing census runs was made on the Missouri River in 1977 during a 119-day period from April 6 to August 2. Specific census dates and locations of river sections surveyed on each date are shown in Table 8. Since only a small portion of the total number of days during the migration period were censused, and only one census run was made on each day sampled, the paddlefish counts presented in this report represent only a portion of the total run and do not necessarily reflect its absolute magnitude.

Table 8. Number of paddlefish counted in electrofishing census runs on the middle Missouri River in 1977.

River Section	Census Dates, 1977											
	4/06	4/07	4/14	4/19	4/21	5/02	5/05	5/19	6/02-6/03	6/14-6/18	6/29-7/08	7/18-8/02
Marias River (152.4)[1/] to Coal Banks Landing (132.1)										0	0	0
Coal Banks Landing (132.1) to Hole-in-the-Wall (110.0)										0	0	0
Hole-in-the-Wall (110.0) to Judith Landing (84.3)										0	0	0
Judith Landing (84.3) to Stafford Ferry (70.8)									0	0	0	0
Stafford Ferry (70.8) to Bird Rapids (57.2)									0	0	0	0
Bird Rapids (57.2) to Cow Island (43.6)									0	0	0	0
Cow Island (43.6) to Grand Island (31.4)									0	0	0	0
Grand Island (31.4) to Robinson Bridge (23.2)						0	0	0	0	3	0	0
Robinson Bridge (23.2) to Slippery Ann (17.2)	0		0	0	2	3	5	7	2	3		
Slippery Ann (17.2) to Rock Creek (10.1)	0	0	0	1	7	8	11	12	12	8		
Rock Creek (10.1) to Fort Peck Res. (0.0)	0	0	3	9	12	30	36	44	24	19		
Total	0	0	3	10	21	41	52	63	38	33	0	0

1/ River miles upstream from Fort Peck Reservoir.

Most of the paddlefish counted in electrofishing census runs during the migration period in 1977 were observed in the lower reach of the Missouri River between Robinson Bridge and Fort Peck Reservoir (Table 8). Only three paddlefish were censused in the Missouri River above Robinson Bridge in 1977. All three were observed on June 18, and the farthest upstream observation was at river mile 25.2, or 2.0 miles above Robinson Bridge. The peak of the paddlefish migration in the lower reach of the Missouri River in 1977 occurred in about mid-May with 63 paddlefish censused between Robinson Bridge and Fort Peck Reservoir on May 19.

Extremely low water conditions in the Missouri River in 1977 undoubtedly account for the relatively small number of paddlefish observed in the Missouri River and the minimal extent of their upstream movements during the migration period. Normally, a substantial number of paddlefish are found in the Missouri River above Robinson Bridge during the migration period. According to Brown (1971) numerous paddlefish observations have been reported in the Missouri River, upstream to the Marias River, 152.4 miles upstream from Fort Peck Reservoir. Brown also reports a paddlefish in the Marias River below Tiber Dam, at a location approximately 80 miles upstream from the mouth.

In a reconnaissance survey of a reach of the Missouri River from Fort Benton to Judith Landing on June 30, 1976, a total of seven paddlefish were counted by visual observation of the fish near the surface of the water. All seven fish were observed in a reach of the Missouri River near the mouth of Little Sandy Creek, 125.6 to 130.0 miles upstream from Fort Peck Reservoir. In addition, two paddlefish were observed in an electrofishing survey near the Little Sandy Creek campground on August 24, 1976. These two fish were believed to be females because of their large size, estimated at 95 pounds each.

An important sport fishery normally occurs each year on the Missouri River in the vicinity of the Little Sandy Creek campground (George Baxter, personal communication). Peak abundance of paddlefish in the Little Sandy Creek area usually occurs around mid-June, compared to a normal peak in mid-May for paddlefish in the Missouri River below Robinson Bridge. The earliest confirmed paddlefish catch by sport fishermen in the Little Sandy Creek area during recent years occurred on May 25, and the latest reported catch was on July 4.

Judging by the concentration of paddlefish that normally occurs during the spawning season, it is likely that the Little Sandy Creek area is a spawning ground for paddlefish in the Missouri River. Other paddlefish spawning grounds are also probably found in the Missouri River in the study area. An attempt will be made during the paddlefish migration period in 1978 to confirm spawning grounds in the Little Sandy Creek area and to locate other paddlefish spawning grounds. Electrofishing survey runs will be used to locate general areas where paddlefish are concentrated. Specific spawning sites will then be identified in these areas using a procedure developed by Purkett (1961). Purkett identified spawning sites of paddlefish on the

Osage River in Missouri by visual observations of spawning fish. He believed that most of the spawning activity of paddlefish on the Osage River occurred underwater, but their spawning behavior also involved appearances of paddlefish on the surface of the water. Paddlefish visible at the surface would agitate the caudal fin several times, then disappear after a few seconds. Surface appearances occurred every few minutes throughout the late afternoon and evening. After dark the "sound" of the agitation at the surface was the only evidence of spawning. Suspected paddlefish spawning grounds on the Missouri River will be observed during the migration period in 1978 to determine if paddlefish in the study area exhibit spawning behavior similar to those on the Osage River.

Other Species

Spawning migration research findings on species other than paddlefish are preliminary at this time, and specific conclusions are unwarranted because of the limited amount of data. Stream flow and water temperature data which have been collected by the U. S. Geological Survey will be analyzed in an attempt to determine correlation of these parameters with the spawning migrations. Research findings will be presented in the next progress report.

Future life history research will be directed toward locating spawning sites of common or important game fish species. Water depth and velocity will be measured at the spawning sites in an attempt to define stream flow requirements for spawning. Identification and monitoring of spawning migrations will be continued. Fish tagging operations will be continued to determine movement patterns of individual spawning fish. An attempt will be made to collect eggs and larval fish to determine incubation period, hatching time and hatching success.

Forage Fish Study

Piscivorous game and nongame fish populations depend, in part, on an adequate forage fish base for their food supply. The major fish species in the middle Missouri River which utilize forage fish for all or part of their diet include sauger, walleye, northern pike, channel catfish, burbot and goldeye.

A forage fish, strictly defined, is any fish that is used as a source of food by other fish (Newell 1975). All fish species during the early stages of their life are small enough to be utilized as a forage food. However, for the purposes of this report, forage fish are defined as those species which, as adults, seldom exceed six inches in length and remain as a food source for their entire lives. This definition was used by Haddix and Estes (1976) in a fishery study on the lower Yellowstone River in Montana.

Forage fish populations were inventoried during 1976 in the eight fish population study sections mentioned previously. The main objective of the sampling was to determine taxonomic composition, longitudinal distribution and habitat requirements (i.e., preferences) of forage fish populations in the study area. Forage fish samples were taken with bag seines and mobile or boom-suspended electrofishing gear.

Most of the forage fish sampling sites were located in confined areas of the river, such as backwaters and side channels, where the presence of forage fish was considered to be likely. Some forage fish were also taken in the main channel, particularly in shoreline and shallow riffle areas.

The most common forage fish species taken in 1976 included flathead chubs, emerald shiners, silvery minnows, longnose dace, mountain suckers, stonecats and mottled sculpin. Mottled sculpins, longnose dace and mountain suckers were most abundant in the upper portion of the Missouri River above the confluence of the Marias River. Flathead chubs, emerald shiners, silvery minnows and stonecats were more common below the confluence of the Marias. Flathead chubs, emerald shiners and silvery minnows were common in backwater, main channel and side channel areas. Longnose dace, mountain suckers, stonecats and mottled sculpins were found exclusively in main channel and side channel areas and primarily in riffle habitat.

Forage fish sampling will be continued through the duration of this study. Additional findings will be presented in future progress reports.

SPORT FISHERY STUDIES

Paddlefish Creel Census

Background

Paddlefish are native to Montana waters, however, little angler interest in them occurred until 1962. At that time a number of paddlefish were taken by fishermen below an irrigation diversion structure on the Yellowstone River near Intake. This fishery stimulated interest in paddlefishing and, in addition to the Yellowstone River fishery, a good fishery now exists in the Missouri River immediately upstream from Fort Peck Reservoir and in the dredge cut pond complex below Fort Peck Dam.

Fishing pressure on paddlefish reportedly has increased considerably in recent years in the Missouri River immediately upstream from Fort Peck Reservoir (Needham 1973). This created the need for information required to evaluate the effect of fisherman harvest on the paddlefish population. In response to this need a creel census study was implemented in 1973 by the Fisheries Division of the Montana Department of Fish and Game (Needham 1973). The study also included tagging of paddlefish and collection of size and sex data. This research was continued by the Fisheries Division in 1974 and 1975 (Needham 1975 and 1976). Although the creel census was not repeated in 1976, general observations suggested that fishing pressure and harvest continued to remain high. Study efforts were therefore resumed on the research project in 1977.

The creel census study section consists of a 15-mile reach of the Missouri River located immediately upstream from Fort Peck Reservoir. Harvest occurs by snagging primarily in the spring as paddlefish migrate upstream from the reservoir. Typical snagging gear consists of a heavy surf-casting rod and reel, 30-80 pound test line, large treble hooks and heavy weights. Occasionally, paddlefish are also caught in the summer and fall, but due to the lower number taken in these seasons only spring harvest was determined.

Creel Period and Coverage

Creel census efforts in 1977 began when the first paddlefish catch was reported on April 15 and extended through June 12 when most of the fishing activity had ceased and harvest rates dropped to a negligible level. Twenty-five (42.4 percent) of 59 days during the creel period were censused. Fishing pressure and harvest were greatest on weekend days and holidays, and 15 (88.2 percent) of 17 of these days were included in the census. A total of 1,004 fishermen was interviewed during the creel census period in 1977. Completed trip data were obtained on 81.3 percent of the fishermen.

Fishing Pressure and Harvest

In 1977 an estimated 1,625 anglers fished 2,526 man-days (8,299 hours) and snagged 900 paddlefish (Table 9). The fisherman harvested 666 (74.0 percent) of the fish caught, and the remainder were released. The overall catch rate averaged 0.36 fish/angler/man-day (0.11 fish/angler/hour) or .55 fish/angler/trip. Harvest rate averaged 0.26 fish/angler/man-day (0.08 fish/angler/hour) or 0.41 fish/angler/trip. The average length of a fisherman trip was 1.55 days in 1977, and the average fisherman spent 3.29 hours per day snagging.

The estimated total weight of the 1977 paddlefish catch in the Missouri River upstream from Fort Peck Reservoir was 46,676 pounds (23.4 tons), with 35,195 pounds (17.6 tons) of paddlefish harvested. By comparison the estimated total harvest of paddlefish in the spring fishery on the Yellowstone River at Intake averaged 76,158 pounds (38.1 tons) annually during a 4-year period from 1972 to 1975 (Elser 1976). Estimated total harvest from a fishery in the tailwaters of Big Bend Dam on the Missouri River in South Dakota averaged 103,846 pounds (51.9 tons) annually during creel censuses conducted in 1970, 1971 and 1973 (Friberg 1974). Paddlefish harvest in a fishery on the Missouri River below Gavins Point Dam in South Dakota totaled 74,269 pounds (37.1 tons) in one snagging season (1972-73) during which a creel census was conducted. The largest sport fishery for paddlefish in the United States occurs in the Osage River above Lake of the Ozarks in Missouri. Total harvest during the two-month snagging season averages about 100 tons annually (Pflieger 1975).

Bank fishermen accounted for 56.6 percent (1,429 man-days) of the estimated total fishing pressure during 1977, but they took only 48.3 percent of the total number of paddlefish harvested for an average harvest rate of 0.23 paddlefish/fisherman/man-day (Table 9). Boat fishermen accounted for 43.4 percent (1,097 man-days) of the total pressure and 51.7 percent of the total harvest for an average harvest rate of 0.31 paddlefish/fisherman/man-day.

Weekend-holiday fishermen accounted for 48.3 percent (1,219 man-days) of the estimated total fishing pressure during 1977, but they took only 46.7 percent of the total number of paddlefish harvested for an average harvest rate of 0.26 paddlefish/fisherman/man-day (Table 9). Week day fishermen accounted for 51.7 percent (1,307 man-days) of the total pressure and 53.3 percent of the total harvest for an average harvest rate of 0.27 paddlefish/fisherman/man-day.

Table 9. Estimates of fisherman, fishing pressure, total catch and harvest, and success rates during the spring snagging season on the paddlefish fishery above Fort Peck Reservoir, April 15 to June 12, 1977.

Statistic	Weekend-Holiday Stratum			Week Day Stratum			Entire Season		
	Bank	Boat	Total	Bank	Boat	Total	Bank	Boat	Total
Number of Fishermen	463	366	829	445	351	796	908	717	1,625
Fisherman Man-days	687	532	1,219	742	565	1,307	1,429	1,097	2,526
Fisherman Hours	2,245	2,074	4,319	2,334	1,646	3,980	4,579	3,720	8,299
No. Paddlefish Caught	215	197	412	233	255	488	448	452	900
No. Paddlefish Harvested	136	175	311	186	169	355	322	344	666
Fish Caught/Man-day	0.31	0.37	0.34	0.31	0.45	0.37	0.31	0.41	0.36
Fish Harvested/Man-day	0.20	0.33	0.26	0.25	0.30	0.27	0.23	0.31	0.26
Avg. Length of Trip (days)	1.48	1.45	1.47	1.67	1.61	1.64	1.57	1.53	1.55
Avg. Hours Fished/Day	3.27	3.90	3.54	3.15	2.91	3.05	3.20	3.39	3.29

Estimates of fishing pressure and paddlefish harvest for the 1977 snagging season are compared with the 1973, 1974 and 1975 season estimate in Table 10. Total fishing pressure and total paddlefish harvest were higher in 1977 than during any of the three previous creel census periods. Low water levels in the Missouri River during the snagging season in 1977 may have been partly responsible for the increased angler pressure and harvest. A number of fishermen interviewed during the creel census period felt that the low water conditions facilitated the snagging of paddlefish. However, the overall fisherman success rate in 1977, in terms of paddlefish harvested/fisherman/man-day, was similar to previous years.

Table 10. A summary of fishing pressure, paddlefish harvest and harvest rates during the spring snagging seasons on the paddlefish fishery above Fort Peck Reservoir, 1973-1975 and 1977.

	Total Fishermen Man-days			Paddlefish Harvested			Harvest/ Fisherman/Day		
Year	Bank	Boat	Total	Bank	Boat	Total	Bank	Boat	Overall
1973	984 (64.9%)	532 (35.1%)	1,516	290 (62.1%)	177 (37.9%)	467	0.29	0.33	0.31
1974	1,422 (63.1%)	831 (36.9%)	2,253	396 (62.2%)	241 (37.8%)	637	0.28	0.29	0.28
1975	916 (61.8%)	566 (38.2%)	1,482	180 (46.7%)	205 (53.3%)	385	0.20	0.36	0.26
1977	1,429 (56.6%)	1,097 (43.4%)	2,526	322 (48.3%)	344 (51.7%)	666	0.23	0.31	0.26

Angler Residency

Angler residence was obtained for 761 fishermen interviewed during the creel census period in 1977. Montana residents accounted for 97.2 percent of the anglers (Table 11). Paddlefish snaggers represented 61 Montana cities and towns with the dominant ones being Billings, Lewistown, and Great Falls. The same three cities dominated in the angler residency of paddlefish snaggers interviewed during previous creel censuses conducted in the study area (Needham 1973, 1975 and 1976).

Size and Sex Composition of Harvested Paddlefish

Length, weight and sex data were obtained from 231 paddlefish harvested during the 1977 snagging season. The paddlefish examined were selected at random throughout the entire creel census period. Average length and weight of paddlefish harvested (males and females combined) was 61.0 inches and 55.6 pounds (Table 12). Females averaged 66.5

Table 11. Angler residence for 761 fishermen interviewed during the paddlefish creel census period in 1977.

Montana Residents	Number of Fishermen	Montana Residents	Number of Fishermen
Billings	122	Helena	14
Lewistown	88	Kalispell	13
Great Falls	85	Winifred	13
Missoula	35	Stanford	12
Bozeman	25	Other Cities[1/]	127
Butte	25		
Jordan	25	Resident Total	740
Laurel	23		
Malta	22	Nonresidents	
Park City	22	Wyoming	12
Grass Range	21	Idaho	6
Harlem	20	Washington	2
Roy	19	California	1
Havre	15		
Deer Lodge	14	Nonresident Total	21

1/ Cities in this category were each represented by 10 or less fishermen.

Table 12. Size of paddlefish harvested in the Missouri River above Fort Peck Reservoir during the spring of 1977.

	Number of Fish	Average Length[1/] (Inches)	Length Range (Inches)	Average Weight (Pounds)	Weight Range (Pounds)
Female	96	66.5	57.0-73.5	78.3	49-111
Male	135	57.1	46.5-68.5	39.4	10-84
Combined	231	61.0	46.5-73.5	55.6	10-111

1/ Length measurement is total length.

inches in length and 78.3 pounds in weight, compared to males which averaged 57.1 inches and 39.4 pounds in length and weight, respectively. The average size of male and female paddlefish harvested in 1977 was similar to the average size of fish harvested in seven previous years (Table 13).

Although the average female paddlefish harvested in 1977 outweighed the average male by a substantial margin, considerable overlap in weight-frequency of the two sexes was observed (Figure 3). Of the 231 paddlefish measured during the spring snagging season in 1977, 43.7 percent occurred in weight intervals which contained both male and female fish. The largest male paddlefish examined in the 1977 harvest weighed 84 pounds, while the smallest female weighed 49 pounds. Sex of these two fish was confirmed by autopsy and examination of gonads. Friberg (1974) also observed considerable overlap in weights of male and female paddlefish harvested in the tailwaters of Big Bend Dam on the Missouri River in South Dakota. The largest male in the Big Bend harvest weighed 65 pounds while the smallest female weighed 35 pounds. Conversely, Elser (1976) and Rehwinkel (1975) observed no overlap in weight-frequency of male and female paddlefish harvested on the Yellowstone River at Intake, Montana.

Females accounted for 41.6 percent of the paddlefish examined in the 1977 harvest, while males comprised 58.4 percent. Since fishermen often select for larger fish which are predominantly females, the observed sex ratio in the harvest may not be the sex ratio of the population.

Table 13. A summary of size data from paddlefish harvested in the Missouri River above Fort Peck Reservoir during eight spring snagging seasons, 1965 to 1977.

	Females			Males		
Year	Number of Fish	Average Length[1/] (Inches)	Average Weight (Pounds)	Number of Fish	Average Length (Inches)	Average Weight (Pounds)
1965	13	67.0	81.5	21	55.4	36.4
1966	36	64.0	74.4	30	53.3	32.1
1970	7	70.2	77.0	2	58.5	44.0
1971	10	66.7	85.7	1	57.0	44.0
1973	46	66.2	76.1	50	54.9	35.0
1974	58	65.3	74.5	67	55.0	32.8
1975	63	65.7	74.8	56	55.9	34.6
1977	96	66.5	78.3	135	56.9	39.4

1/ Length measurement is total length.

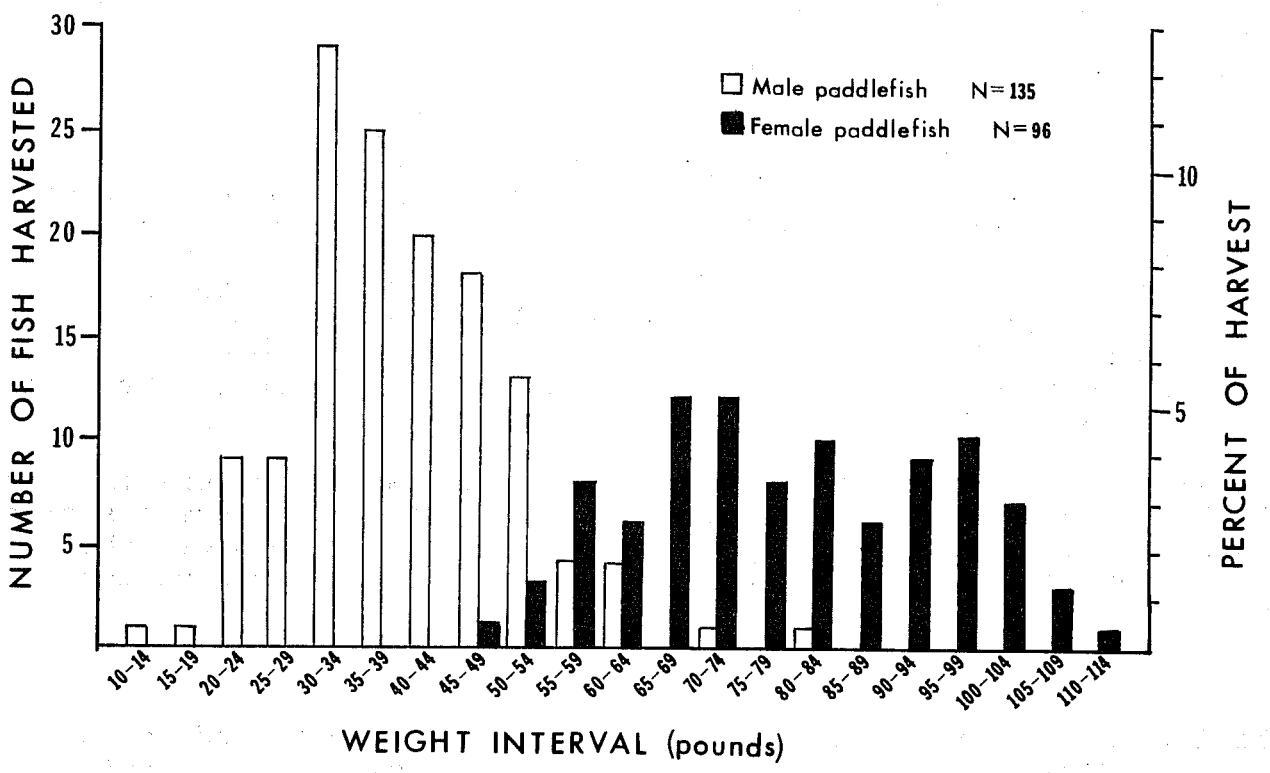

Figure 3. Weight-frequency and sex composition of 231 paddlefish harvested in the Missouri River above Fort Peck Reservoir during the spring of 1977.

Age Structure of Harvested Paddlefish

Dentary bones were collected from 142 paddlefish harvested by fishermen during the 1977 snagging season to determine the age structure of fish in the harvest. The dentary bones were collected at random throughout the entire creel census period, and the data therefore should be representative of the harvest. However, since fishermen often select for larger fish which are usually older in age, the observed age structure of paddlefish in the harvest may not be representative of the age structure of the population.

Paddlefish ages will be determined by cross-sectioning the dentary bones and "reading" the annuli in the mesial arm. Findings will be presented in the next progress report.

Paddlefish Tagging

Sixty-one paddlefish were tagged during the spring migration season in 1977 with individually numbered monel poultry band tags anchored around the dentary bones to obtain information on angler harvest and movement.[1/] Of the fish collected for tagging, 13 were sampled by electrofishing, 44 were taken by snagging and 4 were captured with large mesh gill nets drifted perpendicular to the current. All of the fish were captured in the Missouri River immediately upstream from Fort Peck Reservoir within the boundaries of the 15-mile creel census study section. This brings the total number of paddlefish tagged and released since 1973 to 213. To date, 15 (7.0%) of the tags have been returned by fishermen (Table 14). All of the recaptured fish were harvested in the creel census study section in the same area where they were tagged. Even assuming that all of the tagged fish harvested by fishermen are not reported, the 7.0 percent return figure indicates a relatively low rate of exploitation on the Missouri River-Fort Peck Reservoir paddlefish population.

Discussion

Data collected in research studies conducted since 1965 suggest that the Missouri River-Fort Peck Reservoir paddlefish population is vigorous and the current rate of exploitation by fishermen does not appear to be excessive. The overall success rate of fishermen in 1977, in terms of the number of paddlefish harvested/fisherman/man-day, was similar to previous years (Table 10). Also, the average size of male and female paddlefish harvested in 1977 was similar to previous years (Table 13). In addition, the total number of paddlefish harvested was higher in 1977 than during any of the previous years when creel censuses were conducted. If over exploitation does occur in a paddlefish population, the females will probably be affected first due to fisherman selection (Elser 1976).

1/ Paddlefish tagging assistance was provided by Mike Poore, Fisheries Division, Montana Department of Fish and Game, through Dingell-Johnson Project No. F-5-R-26, Job I-b.

Table 14. A summary of paddlefish tagging and fisherman tag returns in the Missouri River above Fort Peck Reservoir, 1973 to 1977.

Year Tagged	Number of Fish Tagged	Number of Fish Harvested						Percent Harvested
		1973	1974	1975	1976	1977	Total	
1973	45	0	1	1	0	1	3	6.7
1974	55	-	3	0	1	1	5	9.1
1975	29	-	-	0	0	1	1	3.4
1976	23	-	-	-	1	1	2	8.7
1977	61	-	-	-	-	4	4	6.6
Total	213						15	7.0

With only 7.0 percent of the tagged fish returned by fishermen, a relatively low rate of harvest is indicated for the Missouri River-Fort Peck Reservoir paddlefish population. By comparison, 13.8 percent of 3,661 paddlefish tagged on the Yellowstone River at Intake since 1964 have been returned by fishermen (Elser 1976). In data summarized by Carlander (1969), snagging by sport fishermen brought tag return rates 9.8, 12.6 and 12.4 percent in several studies conducted on the paddlefish sport fishery in the tailwaters of Big Bend Dam on the Missouri River in South Dakota. A tag return rate of 24.5 percent in three years following tagging of paddlefish on the Osage River in Missouri was considered by Purkett (1963) to be an excessive rate of exploitation. Angler harvest rates on the Missouri River-Fort Peck Reservoir paddlefish population do not approach this excessive rate. However, additional tagging of paddlefish and exposure of marked fish to the fishery, and further evaluation of fishermen success rates and size and sex composition of harvested fish will be necessary to properly evaluate the effects of exploitation rates on the Missouri River-Fort Peck Reservoir paddlefish population.

Potential habitat losses resulting from activities such as dam building or large-scale water withdrawals probably represent a greater threat to the Missouri River-Fort Peck Reservoir paddlefish population than over exploitation by fishermen. Every effort should be made to protect the middle Missouri River from this type of habitat alteration so the spawning migration can continue undiminished.

Missouri River Fisherman Survey

A fisherman creel survey was initiated in April 1977 on the sport fishery which exists in the 207-mile reach of the Missouri River from Great Falls to Fort Peck Reservoir. This area supports an excellent warm water fish population of great potential recreational value. The seven most common or important game fish species found in the study area include sauger, walleye, northern pike, shovelnose sturgeon, channel catfish, burbot and paddlefish.

The primary objective of the fisherman survey is to determine catch and harvest rates and species composition in the catch and harvest. Survey findings will aid in evaluating the sport fishery in the middle Missouri River so that a sound management plan can be formulated for maintaining and utilizing the resource. Creel survey findings will be presented in a later report when data accumulation becomes substantial enough to warrant interpretation.

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Appendix Table 1. River mileage chart for the middle Missouri River study area. Confluence of the Missouri River with the normal flood pool of Fort Peck Lake is river mile 0.0.

Location	River Mile
Morony Dam	207.0
Belt Creek	205.8
Highwood Creek	199.4
Carter Ferry	190.6
Fort Benton	174.7
Loma Ferry	154.2
Marias River	152.4
Spanish Island	146.2
Virgelle Ferry	135.2
Coal Banks Landing	132.1
Little Sandy Creek	127.2
Eagle Creek	118.0
Hole-in-the-Wall	110.0
Arrow Creek	95.8
Judith River	85.8
Judith Ferry	84.3
Stafford Ferry	70.8
Bird Rapids	57.2
Sturgeon Island	53.1
Cow Island	43.6
Grand Island	31.4
Robinson Bridge	23.2
Slippery Ann Campground	17.2
Rock Creek	10.1
Turkey Joe	0.9
Fort Peck Reservoir	0.0

Appendix Table 2. Species composition, number and size of fish sampled by electrofishing in the Morony Dam study section in 1976.

Fish Species	Number Sampled	Average Length (Inches)	Length Range (Inches)	Average Weight (Pounds)	Weight Range (Pounds)
Goldeye	7	12.16	11.6-13.1	0.59	0.52-0.64
Mountain whitefish	5	12.28	11.2-14.7	0.86	0.60-1.69
Rainbow trout	1	14.6	-	1.07	-
Brown trout	1	21.9	-	4.08	-
Northern pike	1	22.8	-	2.82	-
Burbot	5	25.1	24.6-26.0	3.15	2.50-3.84
Carp	1	19.8	-	3.45	-
River carpsucker	1	16.5	-	2.20	-
Shorthead redhorse	6	18.2	16.3-20.4	2.61	1.92-3.62
Longnose sucker	6	13.7	8.4-18.4	1.36	0.28-2.64
White sucker	2	10.7	9.8-11.6	0.56	0.44-0.68
Mountain sucker	3	7.0	5.7- 8.0	0.18	0.11-0.25
Sauger	56	13.6	10.5-22.1	0.80	0.31-3.31
Walleye	1	30.3	-	11.80	-
Mottled sculpin	1	3.1	-	0.01	-
Total	97				

Appendix Table 3. Species composition, number and size of fish sampled by electrofishing in the Carter Ferry study section in 1976.

Fish Species	Number Sampled	Average Length (Inches)	Length Range (Inches)	Average Weight (Pounds)	Weight Range (Pounds)
Goldeye	31	12.5	11.5-14.4	0.64	0.52-0.94
Mountain whitefish	2	8.7	6.2-11.1	0.25	0.06-0.44
Carp	2	19.6	19.4-19.7	3.52	3.26-3.78
River carpsucker	2	15.8	15.2-16.4	2.16	1.93-2.38
Shorthead redhorse	27	17.8	14.5-20.0	2.49	1.30-2.93
Longnose sucker	45	17.1	12.2-19.8	2.26	0.84-3.38
Sauger	30	14.3	11.4-17.2	0.88	0.44-1.42
Mottled sculpin	1	3.6	-	0.01	-
Total	140				

Appendix Table 4. Species composition, number and size of fish sampled by electrofishing in the Fort Benton study section in 1976.

Fish Species	Number Sampled	Average Length (Inches)	Length Range (Inches)	Average Weight (Pounds)	Weight Range (Pounds)
Shovelnose sturgeon	3	35.5	32.2-40.0	7.13	5.7 - 9.4
Goldeye	92	12.4	11.3-15.1	0.60	0.42- 1.12
Mountain whitefish	1	3.9	-	0.02	-
Brown trout	1	15.7	-	1.48	-
Carp	42	19.5	12.3-24.3	3.65	1.12- 6.8
Flathead chub	13	6.4	3.3- 7.9	0.10	0.01- 0.18
Longnose dace	11	3.1	1.9- 4.6	0.02	0.01- 0.04
River carpsucker	9	15.8	14.3-17.6	1.84	1.30- 2.64
Blue sucker	6	27.0	26.1-28.0	6.18	5.2 - 6.8
Smallmouth buffalo	5	23.9	22.7-26.5	8.24	6.8 -10.8
Bigmouth buffalo	3	27.8	26.0-29.3	13.13	10.6 -15.4
Shorthead redhorse	248	16.6	9.1-19.7	1.96	0.30- 3.38
Longnose sucker	135	14.6	5.9-19.7	1.40	0.08- 2.92
White sucker	11	13.1	8.9-17.4	1.10	0.34- 2.12
Mountain sucker	5	5.2	3.4- 7.3	0.08	0.01- 0.19
Stonecat	1	5.6	-	0.09	-
Burbot	1	23.1	-	2.10	-
Sauger	242	12.1	7.3-23.7	0.55	0.08- 5.3
Walleye	2	26.3	23.2-29.4	8.26	4.41-12.1
Freshwater drum	13	12.6	10.5-14.5	1.06	0.60- 1.69
Mottled sculpin	13	3.2	2.2- 3.8	0.01	0.01
Total	858				

Appendix Table 5. Species composition, number and size of fish sampled by electrofishing in the Loma Ferry study section in 1976.

Fish Species	Number Sampled	Average Length (Inches)	Length Range (Inches)	Average Weight (Pounds)	Weight Range (Pounds)
Shovelnose sturgeon	17	31.7	27.4-36.0	4.98	2.68- 8.0
Goldeye	96	12.0	11.0-13.9	0.56	0.42- 0.84
Northern pike	3	22.1	13.1-29.4	3.98	0.62- 7.6
Carp	33	18.4	9.9-22.7	3.05	0.48- 6.7
Flathead chub	89	4.6	3.1- 8.8	0.05	0.01- 0.24
Emerald shiner	22	2.8	2.0- 3.8	0.01	0.01
River carpsucker	32	15.6	5.3-20.0	1.88	0.10- 3.70
Blue sucker	3	26.2	25.7-26.5	5.73	5.4 - 6.2
Smallmouth buffalo	14	22.1	19.7-25.1	5.91	4.22- 8.6
Bigmouth buffalo	3	25.0	16.7-36.8	8.10	3.11-15.2
Shorthead redhorse	151	16.0	6.8-19.5	1.82	0.12- 3.28
Longnose sucker	151	15.7	5.0-19.5	1.76	0.08- 2.98
White sucker	4	13.2	10.7-16.2	1.04	0.50- 1.58
Burbot	3	20.3	18.6-21.6	1.33	1.06- 1.60
Yellow perch	7	5.6	4.3- 8.7	0.10	0.05 -0.25
Sauger	117	11.5	6.5-18.1	0.50	0.08- 1.86
Walleye	9	19.3	14.0-26.5	3.49	0.86- 8.1
Freshwater drum	14	11.8	10.4-14.9	0.74	0.54- 1.48
Total	768				

Appendix Table 6. Species composition, number and size of fish sampled by electrofishing in the Coal Banks Landing study section in 1976.

Fish Species	Number Sampled	Average Length (Inches)	Length Range (Inches)	Average Weight (Pounds)	Weight Range (Pounds)
Shovelnose sturgeon	19	31.7	28.3-36.2	4.56	3.16-8.0
Goldeye	153	12.2	10.3-13.5	0.63	0.42-0.94
Mountain whitefish	2	7.0	6.7- 7.3	0.12	0.12
Carp	51	18.6	14.4-24.3	3.05	1.32-6.5
Flathead chub	26	6.7	3.7- 9.3	0.15	0.01-0.28
River carpsucker	19	16.4	14.7-18.6	2.04	1.58-3.06
Blue sucker	11	26.9	24.0-29.9	6.23	4.06-9.3
Smallmouth buffalo	13	21.6	18.9-24.2	5.54	3.24-8.5
Shorthead redhorse	173	15.2	3.0-19.7	1.60	0.03-3.58
Longnose sucker	49	14.1	8.0-19.2	1.22	0.02-2.74
White sucker	2	14.4	14.2-14.5	1.21	1.20-1.22
Mountain sucker	1	2.6	-	0.01	-
Stonecat	1	6.2	-	0.12	-
Burbot	4	19.5	10.5-28.0	1.71	0.24-3.90
Sauger	86	13.3	7.5-20.0	0.78	0.10-2.99
Freshwater drum	5	12.0	11.2-12.6	0.83	0.68-0.92
Total	615				

Appendix Table 7. Species composition, number and size of fish sampled by electrofishing in the Judith Landing study section in 1976.

Fish Species	Number Sampled	Average Length (Inches)	Length Range (Inches)	Average Weight (Pounds)	Weight Range (Pounds)
Shovelnose sturgeon	8	29.7	26.1-32.9	3.67	2.10- 5.4
Goldeye	90	12.1	9.2-13.6	0.62	0.31- 1.00
Rainbow trout	1	16.8	-	1.48	-
Carp	26	18.6	15.9-21.9	3.27	1.96- 5.8
Flathead chub	31	6.1	3.5- 8.4	0.11	0.02- 0.28
River carpsucker	27	17.1	7.3-20.2	2.68	0.28- 4.10
Blue sucker	9	21.1	27.2-30.2	9.12	8.0 -12.1
Smallmouth buffalo	8	23.0	19.6-26.7	7.41	4.14-13.2
Shorthead redhorse	108	13.8	6.7-19.5	1.21	0.15- 3.32
Longnose sucker	25	13.0	4.4-18.1	1.06	0.05- 2.43
White sucker	6	10.6	6.5-14.7	0.67	0.07- 1.65
Channel catfish	10	23.6	18.6-27.3	5.79	2.38-10.4
Stonecat	2	6.5	6.5	0.11	0.09- 0.12
Burbot	7	16.4	9.7-21.0	0.87	0.18- 1.66
White crappie	2	7.6	7.0- 8.2	0.23	0.16- 0.30
Sauger	157	11.6	4.6-21.4	0.57	0.02- 3.08
Walleye	1	16.9	-	1.68	-
Freshwater drum	9	12.4	11.0-14.3	0.88	0.68- 1.21
Mottled sculpin	1	2.3	-	0.01	
Total	528				

Appendix Table 8. Species composition, number and size of fish sampled by electrofishing in the Cow Island study section in 1976.

Fish Species	Number Sampled	Average Length (Inches)	Length Range (Inches)	Average Weight (Pounds)	Weight Range (Pounds)
Shovelnose sturgeon	6	28.9	24.7-36.0	2.66	1.12- 3.42
Goldeye	119	12.0	5.5-13.6	0.66	0.09- 1.00
Carp	69	18.8	15.9-24.7	3.11	1.82- 8.4
Flathead chub	10	6.0	3.9- 8.2	0.12	0.03- 0.26
River carpsucker	12	16.7	14.2-18.6	2.38	1.41- 3.55
Blue sucker	19	28.9	25.2-32.0	8.07	4.75-12.6
Smallmouth buffalo	7	22.0	19.3-24.6	5.67	3.76- 7.5
Bigmouth buffalo	1	29.9	-	16.0	-
Shorthead redhorse	37	14.2	8.2-18.3	1.25	0.30- 2.17
Longnose sucker	1	14.5	-	1.16	-
Burbot	1	8.5	-	0.70	-
Sauger	12	10.3	6.0-18.7	0.35	0.10- 1.06
Freshwater drum	3	11.3	10.6-12.1	0.70	0.51- 0.79
Total	297				

Appendix Table 9. Species composition, number and size of fish sampled by electrofishing in the Robinson Bridge study section in 1976.

Fish Species	Number Sampled	Average Length (Inches)	Length Range (Inches)	Average Weight (Pounds)	Weight Range (Pounds)
Shovelnose sturgeon	7	27.9	26.0-29.7	2.51	2.06- 2.78
Goldeye	106	10.9	4.4-14.3	0.52	0.04- 1.10
Carp	30	18.3	12.7-21.9	2.76	0.82- 4.61
Flathead chub	28	4.9	2.5- 9.5	0.16	0.01- 0.31
Emerald shiner	5	3.3	2.8- 3.8	0.01	0.01
River carpsucker	13	17.4	16.0-19.2	2.76	2.09- 4.08
Blue sucker	6	30.4	27.7-33.4	9.38	7.5 -11.5
Smallmouth buffalo	1	24.1	-	7.5	-
Bigmouth buffalo	1	28.1	-	13.0	-
Shorthead redhorse	23	14.5	10.9-17.7	1.20	0.58- 2.18
Longnose sucker	2	9.3	7.9-10.7	0.40	0.21- 0.58
White sucker	1	8.5	-	0.22	-
Channel catfish	1	20.1	-	2.36	-
Burbot	1	25.2	-	3.60	-
White crappie	1	9.7	-	0.52	-
Sauger	36	10.8	5.1-19.7	0.47	0.03- 2.02
Walleye	1	14.0	-	0.75	-
Freshwater drum	3	11.9	10.2-13.0	0.79	0.48- 0.98
Total	266				

Appendix Table 10. Species composition, number and size of fish captured in eight overnight experimental gill nets in the Fort Benton study section in 1976.

Fish Species	Number Sampled	Average Length (Inches)	Length Range (Inches)	Average Weight (Pounds)	Weight Range (Pounds)
Shovelnose sturgeon	3	36.1	34.1-38.0	7.2	6.2 - 8.6
Goldeye	88	12.4	11.1-15.1	0.60	0.40- 1.06
Brown trout	1	18.6	-	4.24	-
Carp	17	20.0	17.4-22.6	3.87	2.64- 5.3
Flathead chub	5	6.2	3.3 -7.8	0.13	0.01- 0.24
River carpsucker	6	16.3	14.8-17.8	1.98	1.26- 2.80
Blue sucker	5	26.9	25.8-27.6	6.00	5.0 - 6.8
Smallmouth buffalo	2	23.7	23.0-24.4	7.50	7.4 - 7.6
Bigmouth buffalo	4	24.1	18.5-28.4	9.18	4.00-13.8
Stonecat	2	5.6	5.4- 5.8	0.09	0.08- 0.10
Shorthead redhorse	21	16.3	11.2-19.3	1.84	0.60- 2.60
Longnose sucker	42	13.0	7.6-18.3	1.04	0.18- 2.88
White sucker	5	13.8	8.8-17.2	1.26	0.30- 2.05
Mountain sucker	3	4.0	3.3- 5.4	0.05	0.04- 0.07
Burbot	2	19.0	15.0-23.0	1.56	1.04- 2.08
Sauger	21	12.3	9.7-16.9	0.56	0.23- 1.20
Walleye	1	24.4	-	6.2	-
Freshwater drum	13	12.3	10.4-14.4	0.97	0.56- 1.62
Total	241				

Appendix Table 11. Species composition, number and size of fish captured in seven overnight experimental gill nets set in the Loma Ferry study section in 1976.

Fish Species	Number Sampled	Average Length (Inches)	Length Range (Inches)	Average Weight (Pounds)	Weight Range (Pounds)
Shovelnose sturgeon	47	31.0	23.2-35.4	4.55	1.84-6.7
Goldeye	281	12.0	7.6-14.1	0.57	0.11-0.91
Carp	7	16.9	15.3-22.5	2.72	1.72-7.3
Flathead chub	3	7.4	6.5- 8.1	0.15	0.11-0.19
River carpsucker	14	15.1	12.3-16.8	1.66	1.05-2.34
Smallmouth buffalo	2	22.8	21.2-24.3	5.85	5.2 -6.7
Shorthead redhorse	13	15.5	8.2-19.3	1.81	0.21-2.96
Longnose sucker	18	16.6	13.9-19.5	2.03	1.28-2.90
Black bullhead	2	7.9	7.5- 8.2	0.17	0.13-0.20
Stonecat	1	7.9	-	0.22	-
Sauger	14	11.5	7.1-15.7	0.43	0.10-1.06
Freshwater drum	2	11.0	12.0-14.0	0.99	0.78-1.20
Total	404				

Appendix Table 12. Species composition, number and size of fish captured in five overnight experimental gill nets set in the Coal Banks Landing study section in 1976.

Fish Species	Number Sampled	Average Length (Inches)	Length Range (Inches)	Average Weight (Pounds)	Weight Range (Pounds)
Goldeye	83	12.1	8.4-13.4	0.60	0.22-0.88
Carp	1	16.1	-	2.08	-
River carpsucker	1	15.8	-	1.70	-
Shorthead redhorse	18	15.1	9.9-19.0	1.46	0.41-2.84
Longnose sucker	4	15.9	15.5-16.5	1.69	1.56-1.88
White sucker	5	14.0	12.7-16.6	1.27	0.89-1.88
Channel catfish	2	29.0	29.0	11.55	10.9 -12.2
Stonecat	1	6.5	-	0.12	-
White crappie	1	6.1	-	0.14	-
Yellow perch	1	7.7	-	0.28	-
Sauger	58	12.4	9.0-19.6	0.63	0.20-2.99
Walleye	1	14.2	-	1.04	-
Total	176				

Appendix Table 13. Species composition, number and size of fish captured in one overnight experimental gill net set in the Judith Landing study section in 1976.

Fish Species	Number Sampled	Average Length (Inches)	Length Range (Inches)	Average Weight (Pounds)	Weight Range (Pounds)
Goldeye	2	11.4	10.2-12.6	0.49	0.36-0.62
White sucker	1	10.3	-	0.42	-
White crappie	4	7.4	7.1- 7.5	0.21	0.18-0.24
Sauger	2	14.1	14.0-14.1	0.73	0.73
Total	9				

Appendix Table 14. Species composition, number and size of fish captured in one overnight experimental gill net set in the Robinson Bridge study section in 1976.

Fish Species	Number Sampled	Average Length (Inches)	Length Range (Inches)	Average Weight (Pounds)	Weight Range (Pounds)
Goldeye	3	12.6	12.5-12.7	0.70	0.66-0.76
Flathead chub	2	8.6	7.7- 9.4	0.24	0.17-0.30
Shorthead redhorse	1	10.9	-	0.58	-
White sucker	1	13.4	-	0.88	-
White crappie	1	7.2	-	0.22	-
Sauger	10	13.9	11.8-15.6	0.79	0.59-1.16
Walleye	1	14.7	-	1.24	-
Total	19				

Seven of the most important or common game fish species found in the middle Missouri River in Montana are shown on this IDENTIFICATION CHART. These species are of particular interest to the Montana Department of Fish and Game, and the department is presently surveying fishermen to provide information about them. Please record your catch for each of these species on the appropriate line of the FISHERMAN SURVEY card.

Most fishermen will also catch some of the other common fish species in the river, such as goldeye, carp, river carpsuckers, longnose and white suckers, etc. If you catch any of these fish, please record the total number you caught on the "Other Kinds" line of the FISHERMAN SURVEY card.

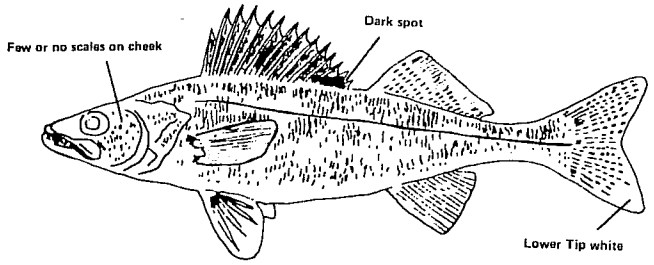
Please mail your completed FISHERMAN SURVEY card. It is postpaid. Your cooperation is appreciated.

Thank you,

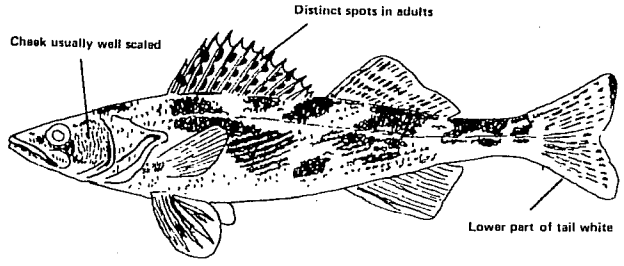
MONTANA DEPARTMENT OF FISH AND GAME

IDENTIFICATION CHART

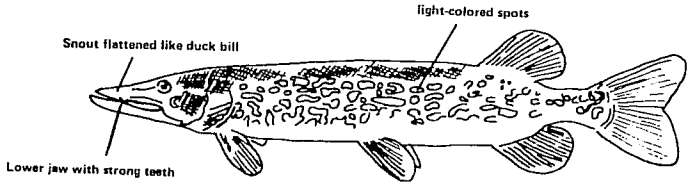
IMPORTANT GAME FISH · MISSOURI RIVER – GREAT FALLS To FORT PECK LAKE



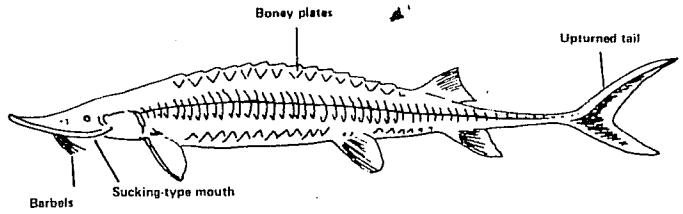
WALLEYE



SAUGER



NORTHERN PIKE



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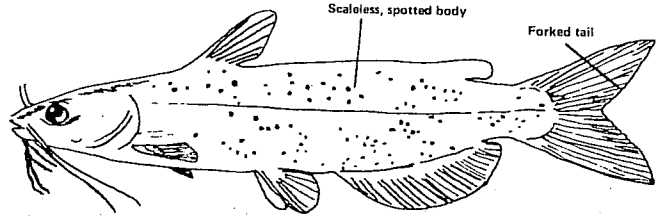
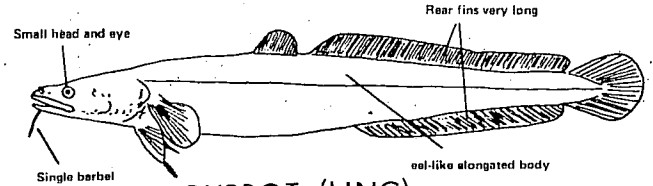
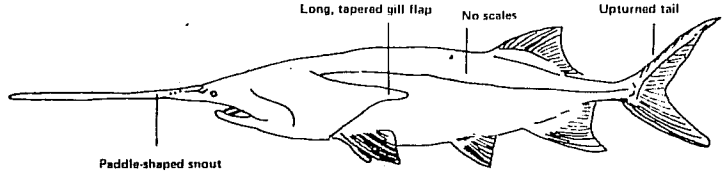


CHANNEL CATFISH



BURBOT (LING)



PADDLEFISH

Appendix
Figure 1. Fish species identification chart for Missouri River fisherman survey.

MONTANA DEPARTMENT OF FISH AND GAME
MISSOURI RIVER FISHERMAN SURVEY – ONE PARTY, ONE TRIP

Please answer the following questions as a combined total for all persons in your party who fished during your trip. Return the card even if you caught no fish.

Number of anglers in party _____ Angler's residence(s) _____
Date(s) fished _____ Section of river fished _____
Total hours spent fishing _____ (combined total for party)
Fishing from: ( )Bank, ( )Boat, ( ) Combination
Method(s): ( ) Setline, ( ) Angling (hand-held line with lure), ( ) Snagging
Lure(s): ( ) Live bait, ( ) Prepared bait, ( ) Artificial lure, other (specify) _____

Fish Species	CATCH	
	Number Kept	Number Released
Sauger		
Walleye		
Sturgeon		
Catfish		
Northern Pike		
Burbot (ling)		
Paddlefish		
Other kinds		

Please mail your completed card. It is postpaid. Your contribution will help to provide a better fisheries resource for Montana sportsmen.

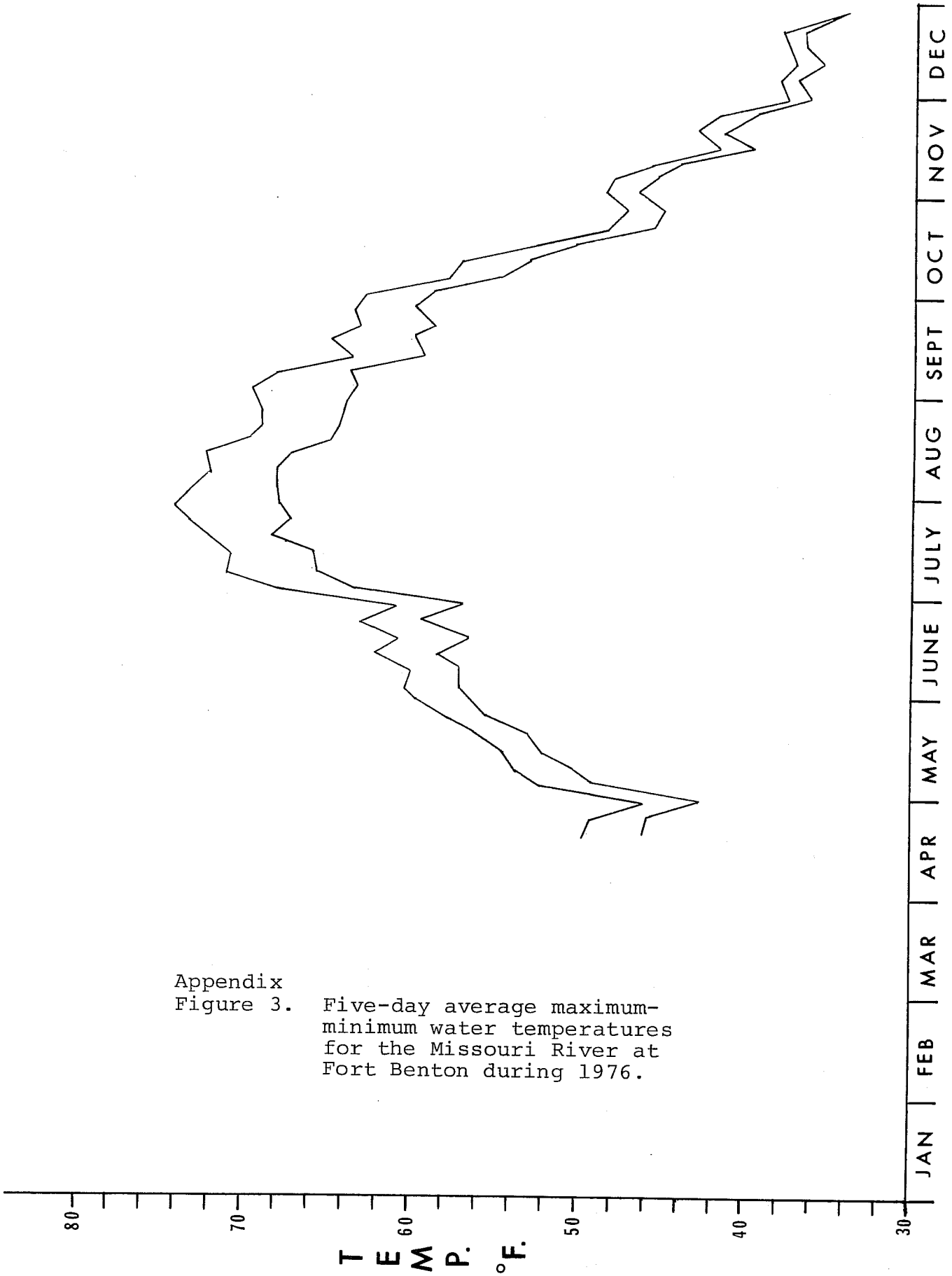
MONTANA DEPARTMENT OF FISH AND GAME
MISSOURI RIVER FISHERMAN SURVEY – ONE ANGLER, ONE TRIP

Angler's residence (city, state) _____ Interview No. _____
Date(s) fished _____ Section of river fished _____
Total hours spent fishing: _____ Fishing Trip: ( ) Complete, ( ) Not Complete
Fishing from: ( ) Bank, ( ) Boat, ( ) Combination
Method(s): ( ) Setline, ( ) Angling (hand-held line with lure), ( ) Snagging
Lure(s): ( ) Live bait, ( ) Prepared bait, ( ) Artificial lure, other (specify) _____

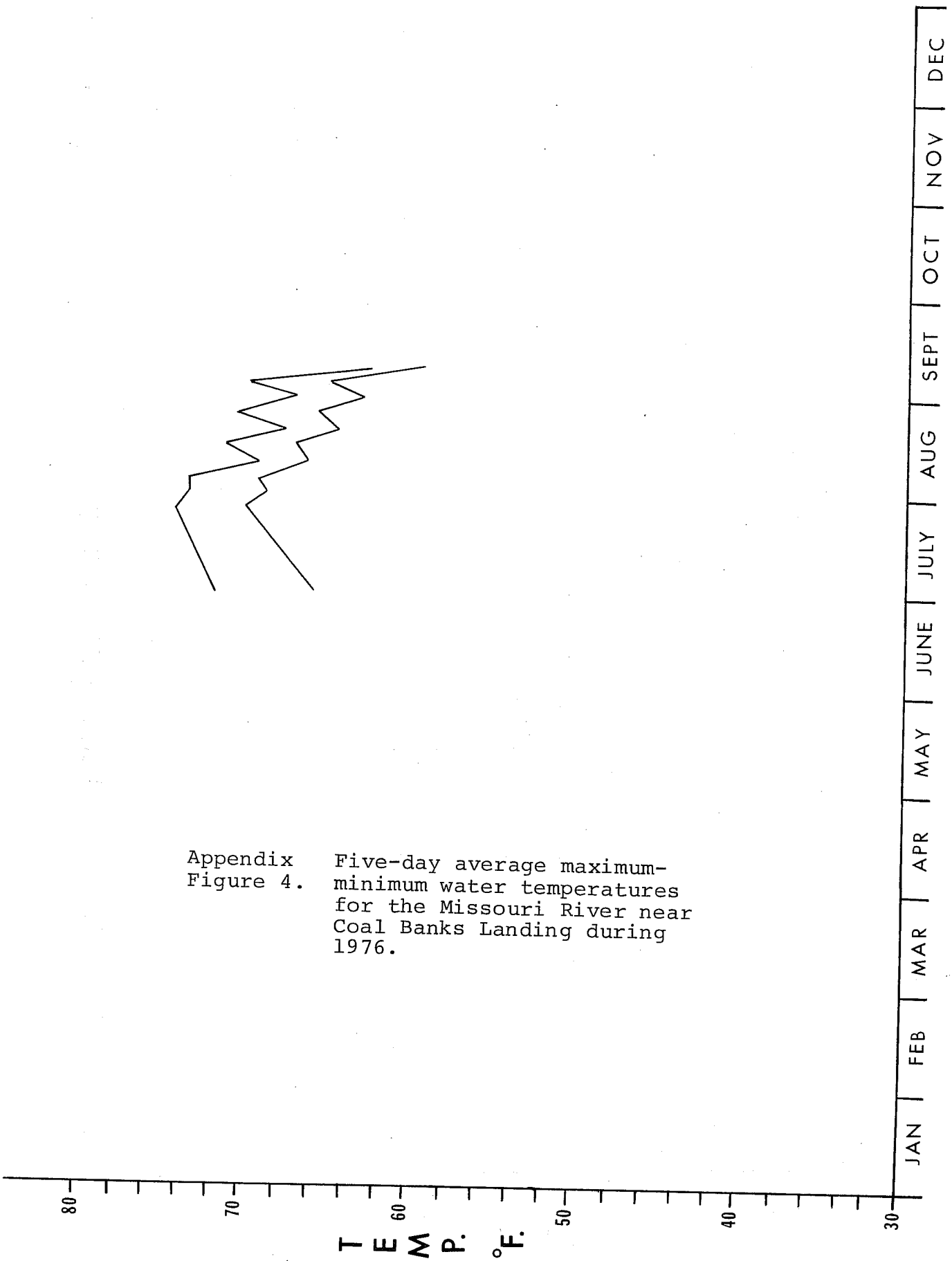
Fish Species	Catch When Interviewed		Additional Catch After Interview	
	Number Kept	Number Released	Number Kept	Number Released
Sauger				
Walleye				
Sturgeon				
Catfish				
Northern Pike				
Burbot (Ling)				
Paddlefish				
Other kinds				

If your fishing trip was not complete when you were contacted, please record any additional fish caught after the interview in the last columns (above). Answer for yourself only, do not include fish caught by others in your party. Additional number of hours spent fishing after interview _____ . Additional date(s) fished after interview: _____ . Please mail your completed card. It is postpaid. Your contribution will help to provide a better fisheries resource for Montana sportsmen.

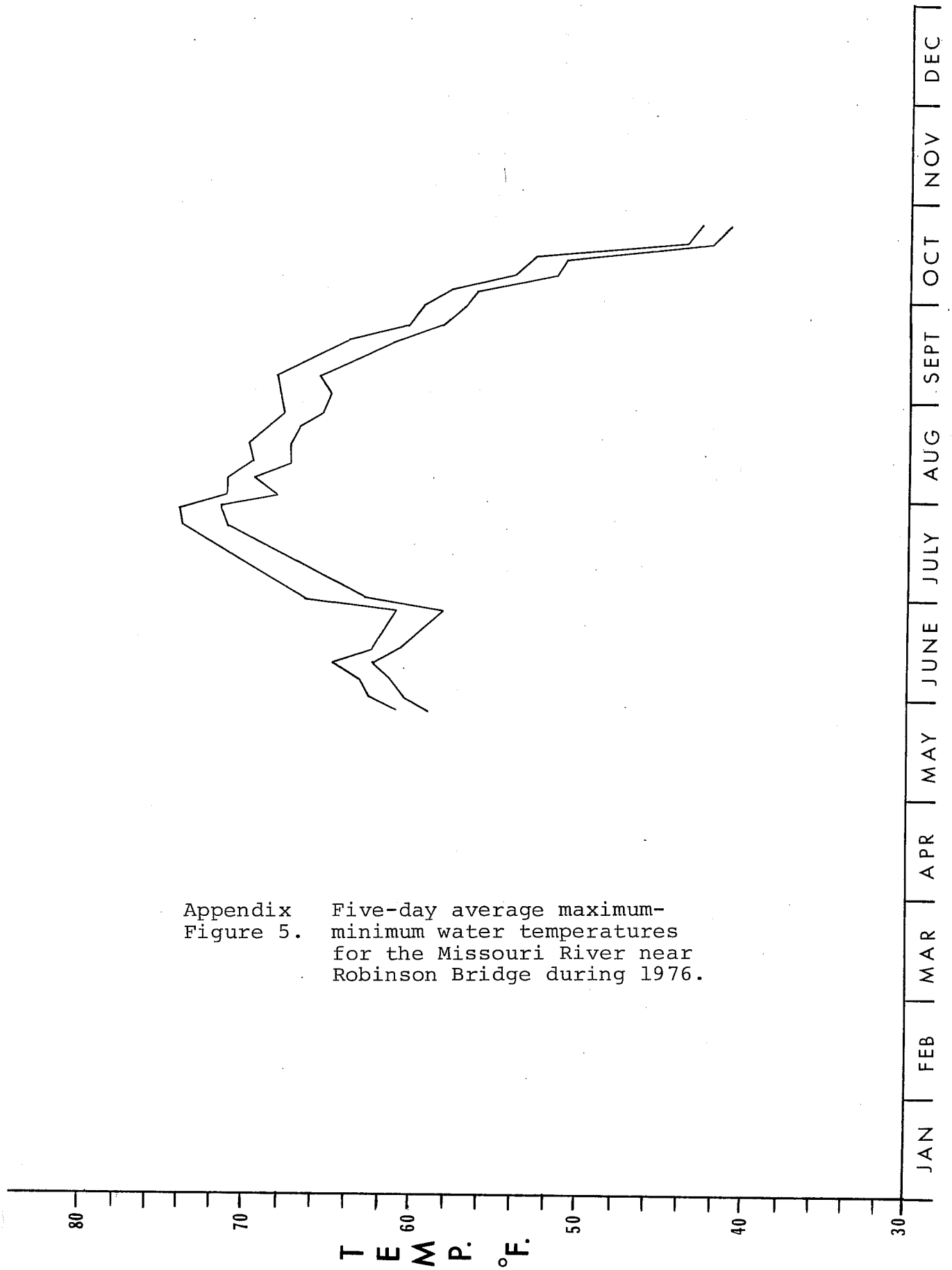
Appendix Figure 2. "Voluntary" (top) and "interview" (bottom) fisherman survey forms used in Missouri River fisherman survey.



Appendix
Figure 3. Five-day average maximum-minimum water temperatures for the Missouri River at Fort Benton during 1976.



Appendix Figure 4. Five-day average maximum-minimum water temperatures for the Missouri River near Coal Banks Landing during 1976.



Appendix Figure 5. Five-day average maximum-minimum water temperatures for the Missouri River near Robinson Bridge during 1976.