THE FISHERY FOR FALL-RUNNING RAINBOW TROUT IN THE MISSOURI RIVER NEAR TOWNSEND, MONTANA

by

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of

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VITA

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ABSTRACT

The trout fishery on 3.5 km of the Missouri River between Townsend, Montana and Canyon Ferry Reservoir was studied during 1978 and 1979. A partial creel census to determine fishing pressure, catch rates, and harvest was conducted on weekdays, weekends, and holidays from July 1 through November 17, 1978 and on weekends and holidays from August 25 through November 16, 1979. In 1978 interviews of 1274 fishermen were conducted. The census showed an estimated 11,673 fisherman hours were expended in harvesting about 7856 trout. About 88.5% of the pressure and 92.5% of the harvest occurred during the second half of the census period. Peaks in the pressure, catch rates, and harvest occurred from 10/7-10/20 1978 and were greatest on the portion of the study area nearest the reservoir. About 97% of the trout harvested during 1978 were rainbow trout with 74% of these being 32 cm or longer. These fish appear to be mainly hatchery-reared trout stocked in the reservoir two or three years prior to their harvest. They move into the study area on a fall run but only a few appear to be attempting to spawn in the fall. Fishing pressure in 1979 was 2% less than in 1978 but the harvest declined 30%. Fewer fish may have been in the study area in 1979 because the discharge from the river was 42% lower than during the census period of 1978.

INTRODUCTION

The 34 km reach of the Missouri River from Toston Dam downstream to Canyon Ferry Reservoir is classified as one of Montana's Blue Ribbon trout streams (Montana Department of Fish and Game 1979). This area supports substantial populations of brown trout (*Salmo trutta*) and rainbow trout (*Salmo gairdneri*) with some individuals of trophy proportions (Montana Department of Fish and Game 1979). The reach has ample public access which allows use by hunters, campers, and boaters as well as fishermen.

In addition to the existing year-round fishery a significant fall fishery for rainbow trout has developed in the river between Townsend and Canyon Ferry Reservoir in recent years. The apparent high utilization of this fishery required that it be evaluated to determine its true importance and to allow measurement of future changes. This need to gather baseline information on the fall fishery was recently emphasized when Montana Vigilante Electric Cooperative Inc. applied to the Federal Energy Regulation Commission for a permit to assess the feasibility of producing hydroelectric power from Toston Dam. Power generation at the dam site could alter the daily flow patterns and adversely impact the fishery below.

The primary purpose of this study was to provide estimates of the fisherman use and harvest on the Missouri River from Townsend to Canyon Ferry Reservoir. A secondary goal was to determine the origin of the

rainbow trout in the fall run and assess their potential for fall spawning. Field work was conducted on weekdays and weekends from July 1 through November 17, 1978 and on weekends and Labor Day during the period of August 25 through November 16, 1979.

DESCRIPTION OF THE STUDY AREA

The Missouri River arises at the confluence of the Madison, Gallatin, and Jefferson rivers near the town of Three Forks in southwestern Montana. From its origin it flows about 40 km in a northerly direction to Toston Dam and then downstream 34 km to Canyon Ferry Reservoir near Townsend, Montana.

Between Toston Dam and Canyon Ferry Reservoir the Missouri River flows through a narrow canyon for 9 km and then downstream across a broad plain for 25 km. The gradient in this 34 km reach of the river is 1.15 m/km. The river channel is braided in the lower portion of this section and contains numerous islands. The river banks and islands harbor cottonwoods and willows intermingled with pasture. Flows in this area are partially regulated by Toston Dam which is a small structure allowing the storage of a limited amount of water for irrigation purposes. Irrigation practices may be impacting the fishery in this section of the river by causing increased siltation, low summer flows, and elevated water temperatures during the summer (Montana Department of Fish and Game 1979).

The primary area of study was the 3.5 km of river lying between the bridge on U.S. Highway 12 and 287 at Townsend and Canyon Ferry Reservoir (Figure 1). In this reach the river is bounded mainly by public lands administered by the Montana Department of Fish, Wildlife, and Parks as a wildlife management area. The channel of the river is

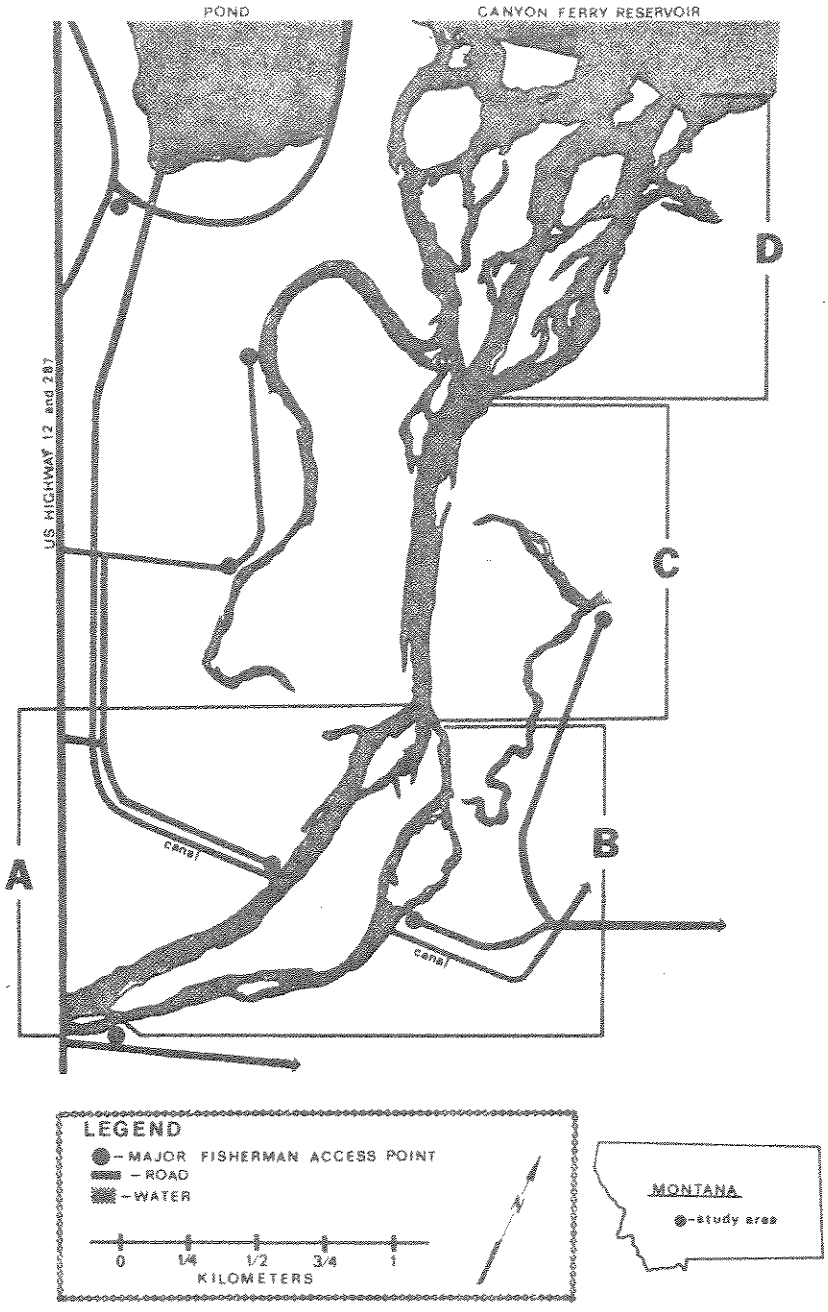

FIGURE 1. MAP OF THE PRIMARY STUDY AREA ON THE MISSOURI RIVER SHOWING THE LOCATION OF STUDY SECTIONS A, B, C, AND D.

highly braided and flows through mixed bottom woodlands. The width of the main channel ranges from about 95 to 210 m and the depth is generally greater than one meter along the thalweg. Most of this section is a deep run with some pools of depths greater than 2.5 m. The substrate is mainly cobble with some shifting sand and silt deposits and gravel. About one half the banks along the channels are composed of gravel and cobble and the other half are clay.

The primary study area was divided into four sections (Figure 1). Section A extended 1.8 km down the main channel from Townsend Bridge to the point of re-entry of the side-channel. The side-channel was designated Section B and was 1.9 km in length. The two other side-channels further downstream didn't maintain a summer flow and were not considered to be significant to this study because they received little fishing pressure. Section C extended 1.3 km downstream from the confluence of Sections A and B to the point where the river channel began to braid to form the delta entering Canyon Ferry Reservoir. The delta was Section D. The main channel in this section varied from 0.4 km to more than 2.0 km in length depending on the level of the reservoir. Only the upper 0.4 km was vegetated. Section D was considered to have 4.0 km of fishing water available, this being the sum of the lengths of the three main channels at the midpoint of the sampling season. Sections A, B, C, and D represent 20.0%, 21.1%, 14.4%, and 44.4% respectively of the total channel length on the primary study area.

The 31 km reach from Toston Dam to Townsend Bridge was less intensively studied and is referred to as the secondary study area or upriver section. This section has several public access sites in addition to some available access points on private land.

The flows and temperatures of the Missouri River were recorded at a U.S. Geological Survey hydrological monitoring station located about midway between Toston Dam and the town of Toston. The average discharge at this point the past 43 years was 5,378 cfs. Extreme flows were 562 cfs on April 30, 1941 and 32,000 cfs on June 6, 1948 (U.S.G.S. 1979). Weekly averages of mean daily discharges for the period January 1978 through December 1979 are shown in Figure 2 (U.S.G.S. unpublished data). Peak flow during the two-year period of study was 15,900 cfs mean discharge on June 11, 1978 and the low flow was 1630 cfs mean discharge on August 11 and 12, 1979. Biweekly averages of mean daily discharges during the 20-week sampling season of 1978 and equivalent period of 1979 are shown in Appendix Table 15. Weekly averages of daily maximum temperatures for 1978 and 1979 are represented in Figure 3 (U.S.G.S. unpublished data). Extremes for the period were a daily maximum of 25.3 C on July 19, 1979 with several low readings of 0 C during November through March of both years. The averages of daily maximum temperatures for each two-week period during the sampling season are shown in Appendix Table 16.

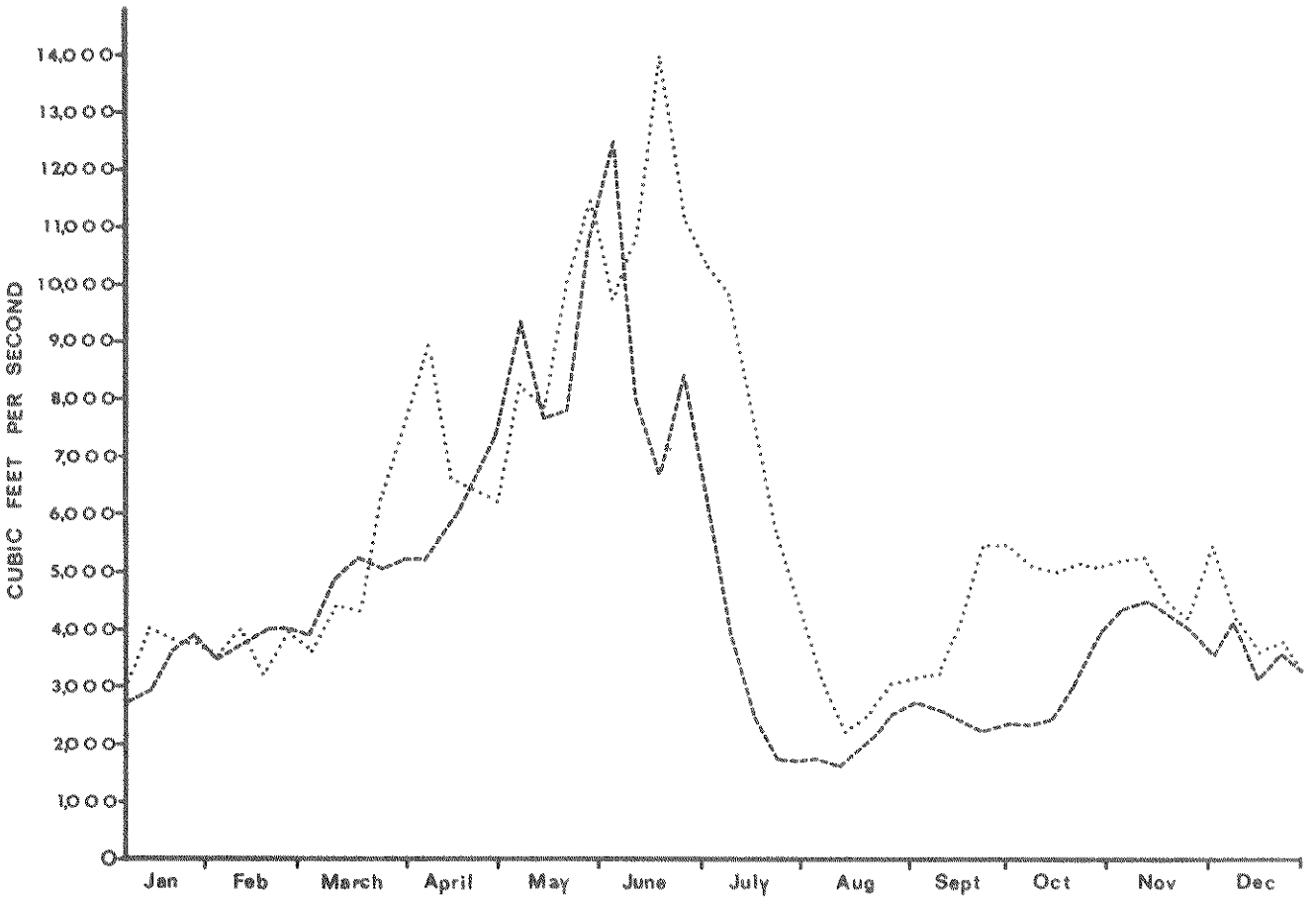

FIGURE 2. MEAN WEEKLY DISCHARGE OF THE MISSOURI RIVER AT TOSTON DURING 1978 (DOTTED LINE) AND 1979 (DASHED LINE). (U.S.G.S. UNPUBLISHED DATA).

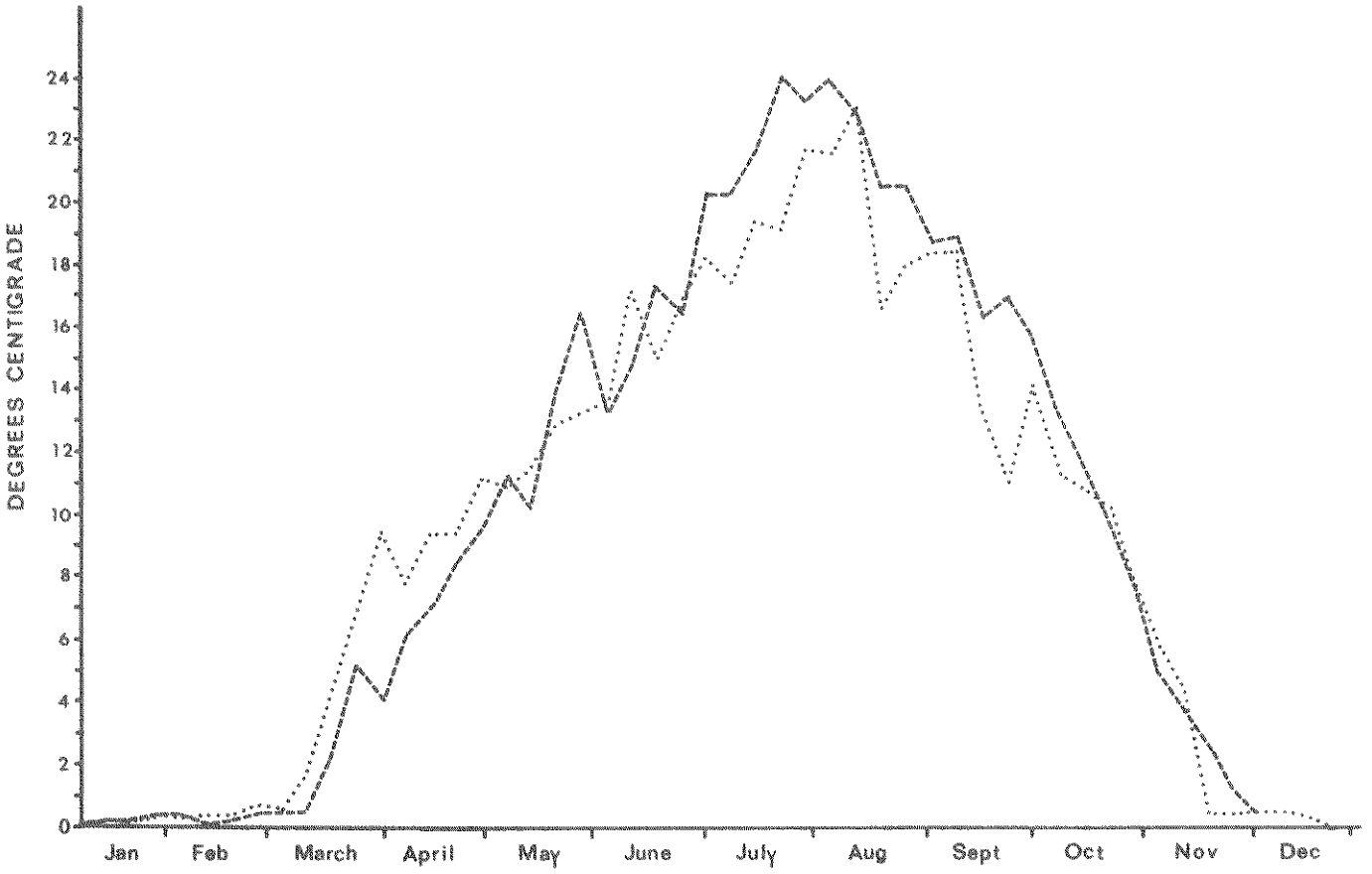

FIGURE 3. MEAN WEEKLY MAXIMUM TEMPERATURE OF THE MISSOURI RIVER AT TOSTON DURING 1978 (DOTTED LINE) AND 1979 (DASHED LINE). (U.S.G.S. UNPUBLISHED DATA).

The major game fish species sought by anglers in the study area were rainbow trout (*Salmo gairdneri*) and brown trout (*Salmo trutta*). Mountain whitefish (*Prosopium williamsoni*) also were abundant but not usually sought by anglers. The major nongame species present were white suckers (*Catostomus commersoni*) and longnose suckers (*Catostomus catostomus*). Carp (*Cyprinus carpio*) were very abundant in the river during the spring and summer but moved back down into the lake after September.

METHODS

A partial creel census was conducted on the study area from July 1 through November 17, 1978 using a modification of the method of Neuhold and Lu (1957). The period of study was divided into ten intervals called strata, each of which ran for two weeks from Saturday through Friday.

Weekdays were treated separately from weekend days in the sampling schedule. Five weekdays were sampled in each stratum. They were selected at random with the stipulations that each day of the week (Monday, Tuesday, etc.) be sampled only once within the stratum and that no one week could contain more than three weekdays to be censused. One half of the weekend days within each stratum were also sampled. The first Saturday of the first stratum was randomly picked as a census day with the following weekends being censused on alternating weekend days (Saturday, Sunday, Saturday, etc.) throughout the 20-week sampling period. In addition, the holidays of Tuesday July 4 and Labor Day on Monday September 4 were censused and treated as weekend days. Thus, in each two-week stratum every day of the week (Monday, Tuesday, etc.) was sampled once. The Tuesday and Monday respectively of the two strata containing holidays were censused more than once.

Four counts of fishermen were made on each census day with the counts being distributed throughout the daylight hours. In Strata 1-5 the initial count of the day was made at 6, 7, 8, or 9 AM with each

subsequent count at 4-hour intervals. The time of the initial count on the first Saturday and first Sunday of the season, first weekday in each stratum, and on each of the holidays was randomly chosen. The time of the initial count on the second and subsequent weekdays or weekend days censused was advanced one hour with 6 AM following the 9 AM starting time.

The schedule of fisherman counts in the fall was modified as the days grew shorter. During Strata 6-7 initial counts were made at 7, 8, 9, or 10 AM with succeeding counts at intervals of three hours. During Strata 8-10 the initial count was conducted at 7, 8, or 9 AM only with subsequent counts at intervals of three hours.

In 1979 one weekend day each week was sampled between August 25 and November 16. In addition, the Labor Day holiday on Monday, September 3 was censused. Census days were chosen in alternating fashion as in 1978 but starting counts were made at 7, 8, or 9 AM only with subsequent counts at intervals of three hours. The time for the initial count on the first sample day was randomly chosen with initial counts on subsequent sampling days throughout the season being advanced one hour, 7 AM following 9 AM. Estimates for Weekend-Holiday Periods are thus for the eight weekend days in each four-week period plus Labor Day in Period 1.

Numbers of fishermen in the study area were counted using binoculars from five selected vantage points. Each count was made in 45

minutes or less and was thus considered to be instantaneous (Neuhold and Lu 1957). The order in which the stations were counted was reversed on each successive count to reduce bias. Counts were also made from a fixed-wing aircraft on four days while simultaneous counts on the ground were conducted to allow an assessment of the completeness and accuracy of counts made on the ground route.

Fishermen were interviewed between counts and after the final count of the day. An attempt was made to conduct interviews in the four study sections in proportion to the amount of fishing pressure in each section at that time. Supplemental information was also obtained by interviewing fishermen who had floated the river on the secondary study area and were taking boats out at Townsend Bridge.

Each fisherman was interviewed individually to determine the number of hours spent fishing, whether he was done fishing on the study area for the day, his residency, bait used, and the number of fish kept and released. The catch was examined and species and length of fish in the creel were recorded. A random sample of fish was weighed and samples of scales were taken for determination of the age structure of the harvest. The form of the dorsal fin was used to classify specimens of rainbow trout as either wild fish or hatchery fish. A sample of rainbow trout larger than 32 cm were also examined during September and October of 1978 and 1979 to determine the relative

size and appearance of the gonads and sex ratio of fish in the harvest.

The data obtained from counts and interviews were analyzed at the Montana State University Statistical Lab. Fishing pressure, catch rates, and harvest in each section for each 2-week stratum were estimated for 1978 following the procedures of Neuhold and Lu (1957). In addition, estimates were formulated for three successive 4-week periods of weekends and holidays in 1978 and 1979. Pressure estimates were based on the average number of daylight hours during that stratum under consideration and not upon the number of hours covered by the counting schedule although the two were in general agreement.

Fish were captured in the fall of 1978 and 1979 and spring of 1979 by electrofishing. Captured fish were weighed and measured and those over about 30 cm in length were affixed with a numbered plastic Floy tag anchored near the dorsal fin. Information on the movement of tagged fish was obtained from creel census and electrofishing on the study area and voluntary tag returns by anglers fishing outside the study area.

RESULTS

Fishing Pressure

Hours Fished and their Distribution

The estimated fishing pressure on the primary study area was nearly 12,000 hours during the 20-week census period of 1978 (Table 1). This is almost 1,300 hrs/km over the 9.0 km length of stream available to fishermen. Fishing pressure averaged 437, 801, 1063, and 3849 hrs/km on the West Gallatin River (Lyden 1973), the Big Hole River (Kozakiewicz 1979), the Madison River (Vincent 1969), and a very heavily fished portion of the Bighorn River (Stevenson 1975) respectively. The 95% confidence limits for total fisherman hours in this study were about 8% of the total hours (Table 1). Accuracies of about 9-13% of total fisherman hours were obtained in other creel census studies on streams in Montana (Peterson 1974, Stevenson 1975, and Kozakiewicz 1979).

The fishing pressure in Section D was about 250-275% greater than in the other three study sections in the primary study area (Table 1). However, the total length of the channel in this section was also about 210-310% greater than in the other sections. The fisherman hrs/km within each section was within 6-25% of each other.

Fishing pressure was not distributed evenly over time. The fishing pressure in Strata 1-5 accounted for little more than 11% of the total fishing pressure although this interval comprised 50% of the

TABLE 1. THE ESTIMATED NUMBERS OF FISHERMAN HOURS AND PERCENTS OF TOTAL HOURS (IN PARENTHESES) ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING 1978.

Stratum	Dates	Section A	Section B	Section C	Section D	Stratum Totals
1	7/1-7/14	96.7	7.4	29.8	0.0	133.9 (1.1)
2	7/15-7/28	144.0	16.0	8.0	0.0	168.0 (1.4)
3	7/29-8/11	152.0	40.0	0.0	0.0	192.0 (1.6)
4	8/12-8/25	60.0	105.0	30.0	0.0	195.0 (1.7)
5	8/26-9/8	85.8	177.6	73.5	312.4	649.3 (5.6)
6	9/9-9/22	301.0	364.0	126.0	819.0	1610.0 (13.8)
7	9/23-10/6	409.5	468.0	305.5	1202.5	2385.5 (20.4)
8	10/7-10/20	534.0	606.0	840.0	2016.0	3996.0 (34.2)
9	10/21-11/3	285.2	313.3	429.0	874.5	1902.0 (16.3)
10	11/4-11/17	98.6	47.1	111.4	184.3	441.4 (3.8)
Section totals with 95% confidence limits		2166.8±359.5 (18.6)	2144.4±374.5 (18.4)	1953.2±383.7 (16.7)	5408.7±739.4 (46.3)	11,673.1±981.5

census period. The zero fisherman pressure during Strata 1-4 on Section D was probably largely due to high reservoir levels. During this time the channel in Section D was only about 1.0 km in combined length and relatively inaccessible to fishermen on foot. The remainder of the section was inundated by waters of the reservoir and fishermen in boats there were not counted. As the season progressed Section D became longer, more accessible, and heavily used. Fishing pressure increased from Stratum 4 through Stratum 8 in all sections and then declined. Stratum 8 contained about 34% of the total pressure despite representing only 10% of the census period.

During 1978 about 59% of the fisherman hours were expended during weekdays (Table 2). Similar distributions of the fishing pressure were noted on the Big Hole River (Kozakiewicz 1979) and West Gallatin River (Lyden 1973).

The estimated numbers of fisherman hours expended on weekends-holidays in 1978 and 1979 are given in Table 3. The total pressure in 1979 was 2% less than in 1978. The pressures in Sections A and C were nearly identical in 1978 and 1979. Section D showed an increase of 33% in total fisherman hours during 1979. The fisherman pressure in Section B was down 79% in 1979.

The pressure on weekends-holidays was 59% greater, and 7% and 41% less in Periods 1, 2, and 3 of 1979 than in 1978 respectively. No noticeable differences in general weather patterns occurred between the

TABLE 2. THE ESTIMATED NUMBERS OF FISHERMAN HOURS AND PERCENTS OF STRATA TOTALS (IN PARENTHESES) EXPENDED ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING WEEKDAYS AND WEEKENDS-HOLIDAYS DURING 1978.

Strata	Dates	Hours during weekdays		Hours during weekends-holidays		Total fisherman hours
1-2	7/1-7/28	168.5	(55.8)	133.4	(44.2)	301.9
3-4	7/29-8/25	208.6	(53.9)	178.4	(46.1)	387.0
5-6	8/26-9/22	1357.8	(60.1)	901.5	(39.9)	2259.3
7-8	9/23-10/20	3918.2	(61.4)	2463.3	(38.6)	6381.5
9-10	10/21-11/17	1277.2	(54.5)	1066.2	(45.5)	2343.4
Total	7/1-11/17	6930.3	(59.4)	4742.8	(40.6)	11673.1

TABLE 3. THE ESTIMATED NUMBERS OF FISHERMAN HOURS EXPENDED ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING PERIODS OF WEEKENDS-HOLIDAYS IN 1978 AND 1979.

Period	Dates	Section A	Section B	Section C	Section D	Period totals
1	8/26-9/22 1978	170.1	239.4	88.2	403.2	900.9
	8/25-9/21 1979	264.6	31.5	144.9	995.4	1436.4
2	9/23-10/20 1978	387.5	468.8	500.0	1106.2	2462.5
	9/22-10/19 1979	400.0	118.8	537.5	1225.0	2281.3
3	10/21-11/17 1978	231.0	173.2	262.5	399.0	1065.7
	10/20-11/16 1979	105.0	36.8	157.5	325.5	624.8
Section totals	8/26-11/17 1978	788.6	881.4	850.7	1908.4	4429.1
	8/25-11/16 1979	769.6	187.1	839.9	2545.9	4342.5

two years. Rather, it appeared that fishermen began using the study area earlier in the season in 1979 in anticipation of good fishing similar to that experienced in 1978. Use declined when the heavy fall run did not materialize.

The average number of fishermen on the study area during each hour of the day is shown in Figure 4. Strata 1-5 show an even distribution that is typical of low fishing intensity (Peterson 1970, Lyden 1973, and Stevenson 1975). Strata 6-10 show a strongly bimodal curve with peaks at 12 and 3 PM. Bimodal curves are characteristic of higher fishing pressure (Peterson 1970, Lyden 1973, Stevenson 1975). The strong modes occurring at midday could be due to large numbers of fishermen concentrating during the warmest part of the day when fishing may be more pleasant in the fall.

Factors Influencing Fishing Pressure Estimates

The results of the four concurrent ground and aerial counts conducted in 1978 are shown in Appendix Table 17. Individual counts from the ground ranged from 70 to 83% of the aerial count with the total number counted from the ground being 79.3% of the count from the air. This indicates the estimates of fishing pressure presented in Table 1 are probably underestimates and should be expanded by a factor of about 1.3 times. Farr and Blake (1979) used an expansion factor of 1.2 times to correct their counts made from the ground based on the results from five concurrent helicopter counts of anglers in a creel census study.

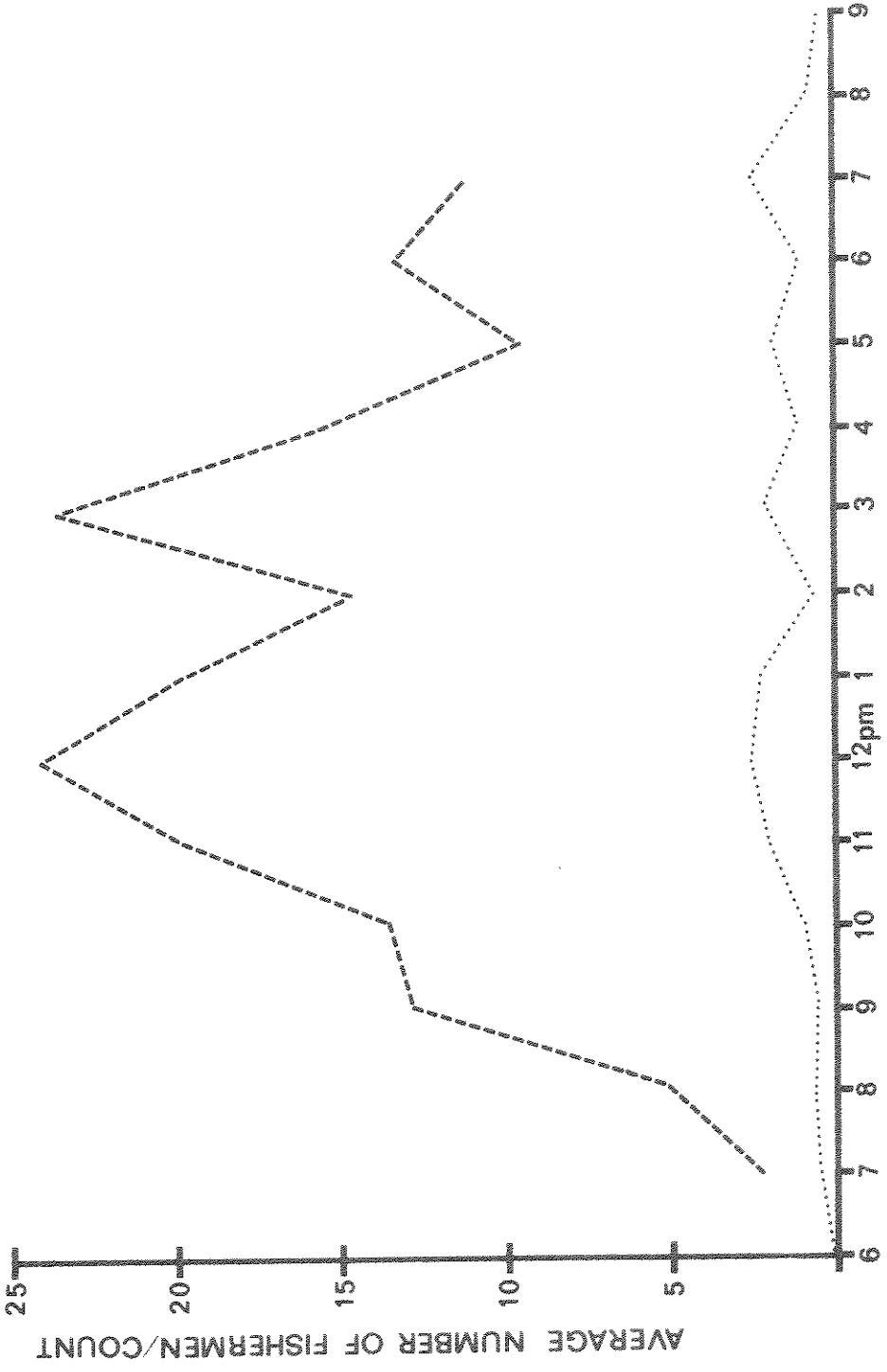

FIGURE 4. THE AVERAGE NUMBER OF FISHERMEN COUNTED/HR ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING 7/1-9/8 1978 (DOTTED LINE) AND 9/9-11/17 1978 (DASHED LINE).

The number of hours over which counts of fishermen were made and the average number of daylight hours during each stratum are presented in Appendix Table 18. The total hours over which counts were made did not differ from the available daylight hours by more than two in any stratum. This shows that the counts gave good coverage of the daylight hours.

The estimates of fishing pressure probably encompassed nearly all the yearly fishing pressure the study area received. Casual observations of the study area during the spring indicated little use by fishermen (Don Childress personal communication) and winter fishing was largely precluded by unstable ice in the channels.

Interviews - Primary Study Area

Numbers of Interviews and their Distribution

A total of 1274 fisherman interviews were conducted on the primary study area during 1978. About 30% of the fisherman hours estimated to have been expended were by fishermen who were interviewed. About 71% of these interviews were with fishermen who had completed fishing for the day. About 25%, 20%, 17%, and 38% of the interviews were conducted in Sections A, B, C, and D respectively. These values were within 8% of the percentage of total fisherman hours expended in each of the respective sections (Table 1). About 19% and 81% of the interviews were conducted in Strata 1-5 and Strata 6-10 respectively. This

proportion was within 7% of the distribution of the pressure during these strata.

Fisherman Days

The average length of the fisherman day on the primary study area calculated from the interviews of 904 fishermen who had completed their fishing trips was 3.0 hours (Table 4). The average lengths of the fisherman day on the Madison, West Gallatin, and Big Hole rivers ranged from 2.1 to 4.0 hours (Vincent 1969, Lyden 1973, and Kozakiewicz 1979). The average length of the fishing day was lowest in Section A which may have been due to the easy access to this area for casual fishermen.

Fishermen on the primary study area fished an average of 1.7 hours during Strata 1-5 and 3.3 hours during Strata 6-10 (Table 4). Shorter trip length during the early strata may have been related to hot weather and low fishing success.

Residency of Anglers

The primary study area was mainly used by anglers from Montana residing 50 km or more away. About 23% of the fishermen interviewed were local residents living in the Townsend area. Helena, Bozeman, and Butte area residents made up 21%, 16%, and 9% respectively of the fishermen interviewed. About 11% of the fishermen were from other areas of Montana and the remaining 20% were from out of the state.

TABLE 4. THE NUMBERS OF FISHERMEN INTERVIEWED WITH COMPLETED FISHING TRIPS AND AVERAGE NUMBER OF FISHING HOURS/TRIP ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING 1978.

		Sec. A		Sec. B		Sec. C		Sec. D		Total	
Strata	Dates	Fisherman trips	Hrs/ trip	Fisherman trips	Hrs/ trip	Fisherman trips	Hrs/ trip	Fisherman trips	Hrs/ trip	Fisherman trips	Hrs/ trip
1-5	7/1-9/8	104	1.3	44	1.7	5	2.2	29	2.9	182	1.7
6-10	9/9-11/17	73	2.0	120	3.0	132	3.5	397	3.6	722	3.3
Total	7/1-11/17	177	1.6	164	2.6	137	3.4	426	3.5	904	3.0

Party Size

The average number of fishermen per party interviewed was 2.04. About 43%, 24%, and 16% of the fishermen were in parties of two, three, and one respectively. The remaining 17% of the total fishermen were in large parties of four to nine individuals. These larger size parties represented only 8% of the total fishing parties.

Fishing Methods

The composition of the fishing methods used on the primary study area is presented in Appendix Table 19. Over half the anglers used bait exclusively. Flies, lures, and combinations of bait, fly, or lure were used in equal but lower proportion.

Catch Distribution

The distribution of the catch among 904 anglers who had completed their fishing trips showed 41% kept no trout, 29% kept one or two trout, and 30% kept three or more (Appendix Table 20). About 7% of the anglers were estimated to have kept the bag limit of ten trout or a weight limit of ten pounds plus one trout which was usually reached at about seven trout. Nearly 80% of the fishermen obtaining limits got them in Section D. The average number of trout kept per fisherman with completed trips was 1.98. The 19% of the anglers who kept five or more trout caught 60% of the trout creeled.

Boat Use

On the primary study area about 15% of all fishermen interviewed were using boats. About 3%, 3%, 14%, and 30% of the fishermen interviewed in Sections A, B, C, and D respectively were boat fishermen. Nearly all of the boat use occurred after Stratum 5. Many of the boat fishermen used boats to reach their favored fishing areas but did most of their actual fishing from shore. It appeared that more fishermen used boats in Section D in 1979 than in 1978.

Interviews - Secondary Study Area

The 293 fishermen interviewed on the secondary study area were all boat fishermen who had completed their trips. Of these 61% were interviewed during Strata 1-5 when more fishermen seemed to be floating the river than during Strata 6-10.

The average length of the fishing day on the secondary area was 3.0 hours. The float time from the nearest upstream access point was generally at least two hours. About 37% of the anglers were from the Helena area, 20% were local fishermen, 11% were from the Butte area, and 5% were from the Bozeman area. Nearly 14% were from other areas of Montana and 13% were from out of state.

The average party size on the secondary study area was 2.47 fishermen per group. One, two, and three fishermen comprised 8%, 37%, and

26% of the fishing parties respectively. About 29% of the total number of fishermen were in parties of four to twelve individuals.

On the secondary study area 60% of the anglers used lures, 26% used combinations, 11% used flies, and only 3% used bait. The high use of lures in this area was probably because all fishermen used boats. During 1978 none of the 293 fishermen interviewed on the secondary study area kept more than five fish and 57% kept no trout.

Catch Rates

Harvest Rates

The harvest rate for the primary study area in 1978 was 0.67 trout/hr (Table 5). The harvest rate in Section D was 50-68% greater than in any other section. The harvest rate was 18% greater in Stratum 8 than in the next highest stratum.

The catch rate of trout kept on holidays and weekends in 1979 (Table 6) was 29% less than in the comparable period of 1978. In both years the highest catch rate was in Period 3 and the lowest occurred during the peak pressure of Period 2. The highest harvest rate of any section in both years was in Section D.

Fishermen on the secondary study area had a catch rate of 0.23 trout/hr during the entire season of 1978. This was only 34% of that on the primary study area. The catch rate per stratum on the secondary study area ranged from 0.16-0.36 trout/hr.

TABLE 5. THE CATCH RATES (NUMBER/HR) OF TROUT HARVESTED ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING 1978. ALL CATCH RATES WERE CALCULATED FROM TEN OR MORE INTERVIEWS.

Stratum	Dates	Section A	Section B	Section C	Section D	Weighted Mean
1	7/1-7/14	0.23	-	-	-	0.17
2	7/15-7/28	0.15	-	-	-	0.15
3	7/29-8/11	0.01	-	-	-	0.05
4	8/12-8/25	0.54	0.70	-	-	0.60
5	8/26-9/8	0.55	0.98	-	0.53	0.65
6	9/9-9/22	0.97	0.67	0.74	0.52	0.65
7	9/23-10/6	0.37	0.77	0.29	0.77	0.64
8	10/7-10/20	0.56	0.37	0.52	1.09	0.79
9	10/21-11/3	0.59	0.33	0.74	0.78	0.67
10	11/4-11/17	0.52	-	0.63	0.66	0.59
Weighted Mean	7/1-11/17	0.50	0.56	0.53	0.84	0.67

TABLE 6. THE CATCH RATES (NUMBER/HR) OF TROUT HARVESTED ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING PERIODS OF WEEKENDS-HOLIDAYS IN 1978 AND 1979. ALL CATCH RATES WERE CALCULATED FROM TEN OR MORE INTERVIEWS.

Period	Dates		Section A	Section B	Section C	Section D	Weighted Mean
1	8/26-9/22	1978	0.88	1.01	0.44	0.46	0.68
	8/25-9/21	1979	0.11	0.00	0.78	0.68	0.57
2	9/23-10/20	1978	0.41	0.54	0.39	0.89	0.65
	9/22-10/19	1979	0.34	0.51	0.29	0.44	0.39
3	10/21-11/17	1978	0.67	0.40	0.76	0.93	0.75
	10/20-11/16	1979	0.55	0.39	0.64	0.66	0.62
Weighted Mean	8/26-11/17	1978	0.59	0.64	0.51	0.81	0.68
	8/25-11/16	1979	0.29	0.40	0.44	0.56	0.48

Harvest Plus Release Rates

Catch rates for trout harvested and released in the primary study area are shown in Appendix Table 21. This rate of 1.11 trout/hr was 66% above the rate for trout kept. Over half of the fish released were rainbow trout less than 32 cm long. Fishermen on the Big Hole River released 50% and 52% of the trout they caught in 1977 and 1978 respectively (Kozakiewicz 1979) compared to 40% in this study.

The catch rate for trout kept and released on the secondary study area in 1978 was 0.53 trout/hr. The rates per stratum ranged from 0.22-0.74 trout/hr. Fishermen on this area released 57% of the trout they caught.

Harvest

Numbers of Trout Harvested and their Distribution

The total estimated harvest on the primary study area during 1978 was nearly 8,000 trout (Table 7). This harvest of about 873 trout/km was more than 400% greater than the comparable harvest from the Big Hole and West Gallatin rivers (Kozakiewicz 1979 and Lyden 1973) but only about 50% of that on a section of the Bighorn River (Stevenson 1975).

The harvests in Sections A, B, C, and D were about 606, 634, 802, and 1,129 trout/km respectively. The harvest in Section D accounted

TABLE 7. THE ESTIMATED NUMBERS OF TROUT HARVESTED AND PERCENTS OF TOTALS (IN PARENTHESES) ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING 1978.

Stratum	Dates	Section A	Section B	Section C	Section D	Stratum total	
1	7/1-7/14	22.4	0.0	0.0	0.0	22.4	(0.3)
2	7/15-7/28	21.3	3.2	0.0	0.0	24.5	(0.3)
3	7/29-8/11	2.2	7.3	0.0	0.0	9.5	(0.1)
4	8/12-8/25	32.6	73.7	10.3	0.0	116.6	(1.5)
5	8/26-9/8	46.9	174.3	32.2	166.0	419.4	(5.3)
6	9/9-9/22	293.3	243.3	92.8	424.4	1053.8	(13.4)
7	9/23-10/6	151.3	358.9	87.6	929.7	1527.5	(19.4)
8	10/7-10/20	300.8	224.8	433.3	2192.8	3151.7	(40.1)
9	10/21-11/3	168.8	104.4	316.8	682.2	1272.2	(16.2)
10	11/4-11/17	51.6	14.5	70.2	122.3	258.6	(3.3)
Total	7/1-11/17	1091.2 (13.9)	1204.4 (15.3)	1043.2 (13.3)	4517.4 (57.5)	7856.2	

for about 58% of the total harvest from the primary study area. The harvest was progressively greater in downstream study sections.

The harvest in Stratum 8 was about 40% of the total for the study although this single stratum represented only 10% of the sampling period. The harvest in this stratum was more than 100% greater than in any other stratum.

The total trout harvested during the Weekend-Holiday Periods of 1979 declined 30% from comparable periods in 1978 (Table 8). The major reductions in harvest in 1979 occurred in Sections A and B which were only 48% and 13% respectively of their 1978 totals. The catch rate and

TABLE 8. THE ESTIMATED NUMBERS OF TROUT HARVESTED ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING WEEKEND-HOLIDAY PERIODS OF 1978 AND 1979.

Period	Dates		Section A	Section B	Section C	Section D	Period Totals
1	8/26-9/22	1978	149.7	241.8	38.8	185.5	615.8
	8/25-9/21	1979	29.1	0.0	113.0	676.9	819.0
2	9/23-10/20	1978	158.9	253.2	195.0	984.5	1591.6
	9/22-10/19	1979	136.0	60.6	155.9	539.0	891.5
3	10/21-11/17	1978	154.8	69.3	199.5	371.1	794.7
	10/20-11/16	1979	57.8	14.4	100.8	214.8	387.8
Totals	8/26-11/17	1978	463.4	564.3	433.3	1541.1	3002.1
	8/25-11/16	1979	222.9	75.0	369.7	1430.7	2098.3

fisherman hours in Section B were down 38% and 79% respectively from 1978 (Tables 6 and 3).

During 1979 the harvest during Weekend-Holiday Period 1 was 33% greater than in 1978. However, during Periods 2 and 3 the 1979 harvest was 44% and 51% less respectively than in 1978.

Species Composition of the Harvest

Rainbow trout comprised about 7,611 fish or 97% of the trout harvested on the primary study area during 1978 (Table 9). In 1979 the harvest from the primary study area was 96% rainbow trout (Table 10).

The species composition of trout from the secondary study area was very different. Floaters in this section creeled 61% brown trout in a

TABLE 9. THE ESTIMATED NUMBERS OF RAINBOW AND BROWN TROUT (IN BRACKETS) HARVESTED ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING 1978.

Stratum	Dates	Section A		Section B		Section C		Section D		Stratum Totals	
1	7/1-7/14	16.8	[5.6]	0	[0]	0	[0]	0	[0]	16.8	[5.6]
2	7/15-7/28	17.1	[0]	3.2	[0]	0	[0]	0	[0]	20.3	[0]
3	7/29-8/11	2.2	[0]	3.6	[3.6]	0	[0]	0	[0]	5.8	[3.6]
4	8/12-8/25	29.7	[3.0]	55.3	[18.4]	8.3	[2.1]	0	[0]	93.3	[23.5]
5	8/26-9/8	41.0	[5.9]	171.0	[3.4]	27.6	[4.6]	153.5	[12.5]	393.1	[26.4]
6	9/9-9/22	267.5	[25.7]	210.6	[32.6]	84.0	[8.8]	420.0	[4.4]	982.1	[71.5]
7	9/23-10/6	146.9	[4.5]	331.3	[22.1]	79.2	[8.4]	923.9	[5.9]	1481.3	[40.9]
8	10/7-10/20	290.9	[10.0]	212.6	[12.3]	412.7	[20.6]	2192.8	[0]	3109.0	[42.9]
9	10/21-11/3	163.0	[5.8]	101.5	[2.9]	310.6	[6.2]	682.2	[0]	1257.3	[14.9]
10	11/4-11/17	51.7	[0]	9.7	[4.8]	68.5	[1.8]	122.3	[0]	252.2	[6.6]
Total	7/1-11/17	1026.8	[60.5]	1098.8	[100.1]	990.9	[52.5]	4494.7	[22.8]	7611.2	[235.9]

TABLE 10. THE ESTIMATED NUMBERS OF RAINBOW AND BROWN TROUT (IN BRACKETS) HARVESTED ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING PERIODS OF WEEKENDS AND HOLIDAYS OF 1979.

Period	Dates	Section A	Section B	Section C	Section D	Period Totals
1	8/25-9/21	24.4 [3.5]	0 [0]	108.7 [4.0]	672.3 [4.4]	805.4 [11.9]
2	9/22-10/19	111.9 [24.9]	53.5 [6.7]	158.1 [0]	532.7 [9.6]	856.2 [41.2]
3	10/20-11/16	48.7 [9.3]	11.5 [2.9]	89.6 [11.9]	213.8 [0]	363.6 [24.1]
Total	8/25-11/16	185.0 [37.7]	65.0 [9.6]	356.4 [15.9]	1418.8 [14.0]	2025.2 [77.2]

sample of 255 trout examined from creels in 1978 and 46% brown trout in a sample of 81 trout caught in 1979. In this section rainbow trout are apparently the secondary species in abundance.

Length of Catch

The length distribution of 971 rainbow trout harvested by fishermen on the primary study area during Strata 5-10 of 1978 shows two prominent modes at about 20 and 40 cm and perhaps a third at about 44 cm (Figure 5). There is also a prominent break in the length distribution at about 32 cm. The distribution of lengths of 297 rainbow trout harvested in 1979 was very similar to the 1978 sample but modes were less pronounced.

The length distribution of 551 brown trout captured during Strata 6-10 of 1978 is shown in Figure 6. Fish from both primary and secondary study areas were combined to increase sample size since no differences were apparent in individual distributions. The distribution of brown trout lengths does not show the strong modes evident in the rainbow trout.

Rainbow trout 32 cm or greater in total length comprised about 74% of the harvest of this species in 1978 (Table 11). This size group comprised about 33%, 29%, 80%, and 94% of the rainbow trout taken in Sections A-D respectively. None of the larger rainbow trout were seen in creels of fishermen on the primary study area during Strata 1-3. They first appeared in Stratum 4 and increased their frequency to a

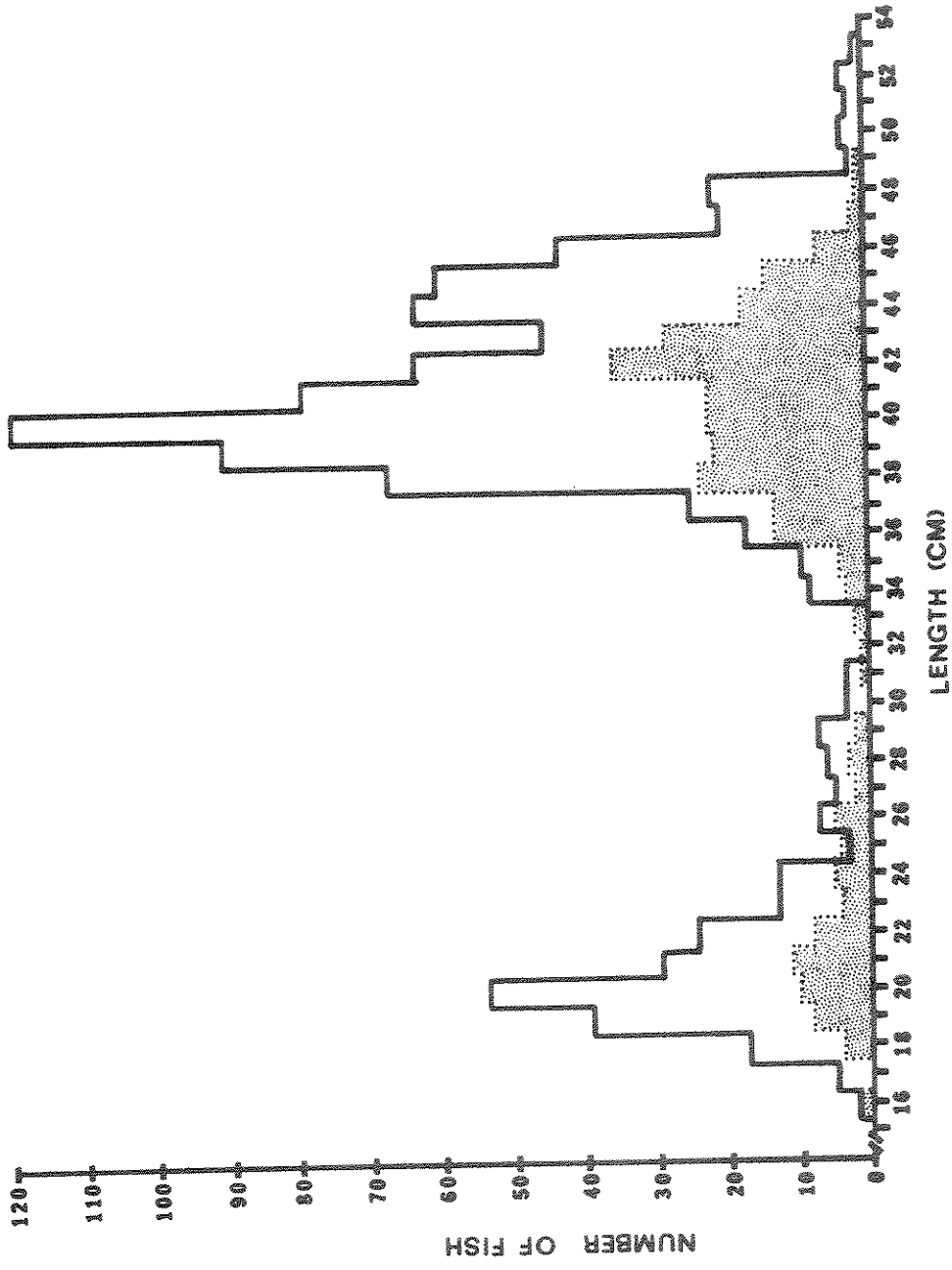

FIGURE 5. THE LENGTH DISTRIBUTION OF 971 RAINBOW TROUT HARVESTED FROM 8/26-11/17 1978 (OPEN FIGURE) AND 297 RAINBOW TROUT HARVESTED FROM 8/25-11/16 1979 (SHADED FIGURE) FROM THE PRIMARY STUDY AREA ON THE MISSOURI RIVER.

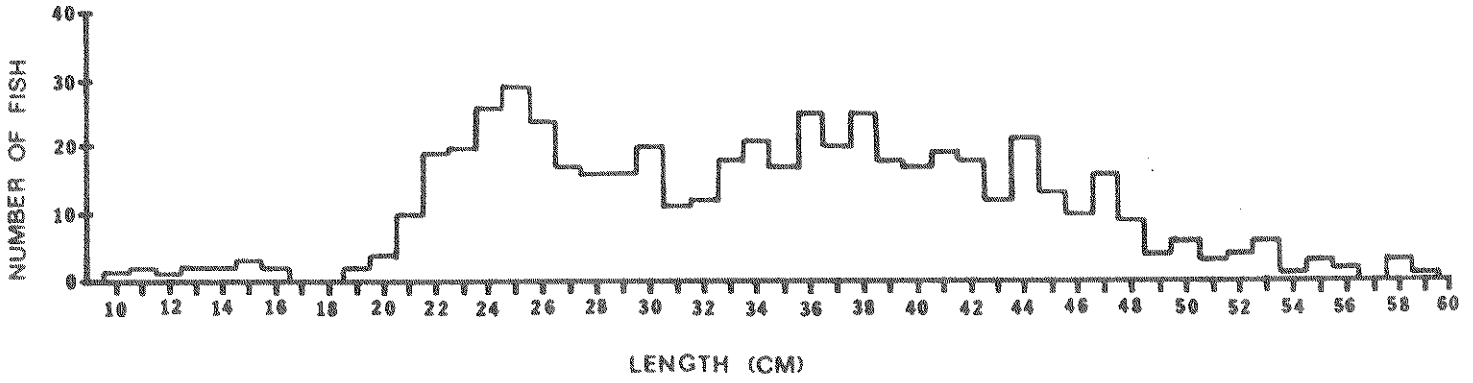

FIGURE 6. THE LENGTH DISTRIBUTION OF 551 BROWN TROUT HARVESTED BY FISHERMEN AND CAPTURED BY ELECTROFISHING FROM THE PRIMARY AND SECONDARY STUDY AREAS ON THE MISSOURI RIVER FROM 8/26-11/15 1978.

TABLE 11. THE ESTIMATED NUMBERS OF RAINBOW TROUT 32 CM IN LENGTH OR GREATER HARVESTED ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING 1978.

Stratum	Dates	Section				Stratum Totals
		A	B	C	D	
1	7/1-7/14	0	0	0	0	0
2	7/15-7/28	0	0	0	0	0
3	7/29-8/11	0	0	0	0	0
4	8/12-8/25	3.0	3.7	2.1	0	8.8
5	8/26-9/8	2.9	3.4	4.6	106.5	117.4
6	9/9-9/22	15.4	21.8	35.4	384.6	457.2
7	9/23-10/6	57.9	99.4	66.7	818.3	1042.3
8	10/7-10/20	160.5	102.2	337.0	2157.0	2756.7
9	10/21-11/3	75.7	78.3	276.1	649.0	1079.1
10	11/4-11/17	23.5	9.7	66.7	107.0	206.9
Section Totals	7/1-11/17	338.9	318.5	788.6	4222.4	5668.4

peak in Stratum 8. Catch rates of large rainbow trout during the fall in Section D further illustrate the apparent increase in their numbers (Table 12). These larger fish appeared to enter the study area from the reservoir on the fall run based on these data and supported by observation from fall electrofishing.

For the primary study area during 1979 the harvest of these larger rainbow trout was down 19%. Sections A, B, C, and D showed respective decreases of 30%, 87%, 56%, and 2%. This appears to

TABLE 12. CATCH RATES (NUMBER/HR) OF RAINBOW TROUT LONGER THAN 32 CM HARVESTED IN SECTION D ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING 1978.

Stratum	5	6	7	8	9	10	Weighted Mean
Catch Rate	0.34	0.47	0.77	1.07	0.74	0.58	0.78

indicate that in 1979 the bulk of the fall run never progressed upriver as it had in 1978.

The average lengths of the rainbow trout and brown trout creeled in 1978 on the primary study area are given in Appendix Table 22. The average length of the rainbow trout was about 3 cm greater than for brown trout. There was a pronounced trend toward an increase in the average size of rainbow trout in the creel as the season progressed. This was attributed to the greater frequency of larger fish entering the catch beginning in September. Any trends in the size of brown trout harvested were less evident.

The average lengths of rainbow and brown trout harvested in 1979 are presented in Appendix Table 23. The average length of rainbow trout was about the same as in 1978.

Age-Length Relationships of the Populations

The ages of 1159 rainbow trout were estimated from scales taken from fish in the harvest and those gathered by electrofishing. The age-length relationships are given in Table 13. The mean total lengths

TABLE 13. THE ESTIMATED AGE-LENGTH RELATIONSHIPS IN RAINBOW TROUT DERIVED FROM EXAMINATION OF SCALES.

	8/26-11/17 1978						8/25-11/16 1979		
	Primary Study Area			Secondary Study Area			Primary Study Area		
Fish Age	Number	Mean Length	Standard Deviation	Number	Mean Length	Standard Deviation	Number	Mean Length	Standard Deviation
0+	41	16.44	2.74	2	13.05	6.29	7	16.57	1.90
1+	195	22.06	3.33	51	16.20	3.30	51	19.82	2.94
2+	218	39.03	4.12	76	26.85	6.29	68	34.08	6.57
3+	178	44.53	3.22	56	36.93	7.27	110	41.50	3.63
4+ and older	40	47.96	4.64	40	44.71	4.46	26	42.45	5.03
Total	672	34.72		225	30.00		262	34.78	

of fish with scales bearing 1, 2, and 3 annuli (1+, 2+, and 3+ aged fish) on the primary study section are similar to the three modes in the length frequency distribution (Figure 5). The length of rainbow trout in the harvest of 1978 (74% were 32 cm or longer) indicates that the bulk of the harvest is probably composed of age 2+ and 3+ fish.

Age 1+, 2+, and 3+ fish from the primary study area were 36%, 45%, and 21% greater in length than those from the secondary study area at the same ages (Table 13). The apparent size difference is probably the result of stocking 10-15 cm hatchery fish in the reservoir during the spring and summer which are considerably greater in length than the wild fish of the same age. The frequency of occurrence of these stocked fish in the primary study area is apparently much higher than in the secondary study area. In addition, growth rates of reservoir fish probably exceed those for fish in the river.

Rainbow trout averaged 10%, 13%, and 7% shorter in length at ages 1+, 2+, and 3+ respectively in 1979 than in 1978. All differences were significant at the 0.99 level using a Student's T-test. It appears the 1979 growing season was less beneficial than in 1978 for some unknown reason.

The ages of 551 brown trout taken by fishermen and electrofishing were estimated from scale samples. Of 139 trout from the harvest 1%, 10%, 27%, and 62% respectively were aged at 1+, 2+, 3+, and 4+ and older. Mean total lengths of all trout in age groups 1+, 2+, and 3+

were 12.81, 22.65, and 27.36 cm respectively. Age 4+ and older fish are difficult to age with any degree of accuracy but these fish appear to make up over half the brown trout harvest. The growth rate for brown trout is apparently much slower than for rainbow trout.

Contribution of Hatchery Fish to the Harvest

An attempt was made to determine the contribution of hatchery rainbow trout to the harvest by examining 1028 fish during 1978. Hatchery trout were judged to be those fish with structural deformities in the dorsal fin rays. About 58% and 34% of the rainbow trout from the primary and secondary study areas were considered to have some evidence of hatchery origin (Table 14). This is probably a minimum figure and may be a large underestimate of the percentage of hatchery fish. Some of the fish planted are known to lack evidence of deformities at the time they are stocked. In addition, most of the rainbow trout are stocked into Canyon Ferry Reservoir at lengths of 10-15 cm and subsequent growth may have eliminated any deformities that were originally present.

TABLE 14. THE NUMBERS AND PERCENTS (IN PARENTHESES) OF HATCHERY AND WILD RAINBOW TROUT IN SAMPLES OF THE 1978 HARVEST FROM THE PRIMARY AND SECONDARY STUDY AREAS ON THE MISSOURI RIVER.

Area	Wild Fish	Hatchery Fish
Primary Study Area	402 (41.9)	558 (58.1)
Secondary Study Area	45 (66.2)	23 (33.8)

Sex Ratio and Reproductive Condition of Rainbow Trout

The sex ratio and reproductive condition of 230 and 95 rainbow trout longer than 32 cm taken on the primary study area in 1978 and 1979 respectively are given in Appendix Table 24. Males comprised 57% and 48% of the samples in 1978 and 1979 respectively.

Only 4% of the females and 11% of the males examined in 1978 appeared to be in spawning condition or to have recently spawned. None of the females and 7% of the males taken in the harvest in 1979 were in spawning condition. However, one female was taken by electrofishing which appeared to have spawned recently. The fall run appears to contain a few fish which may attempt to spawn but does not appear to be a fall spawning run.

Movement of Rainbow Trout

One hundred ninety three rainbow trout were tagged on the primary study area in the two years of this study. An additional 209 were tagged between Toston and the primary study area by personnel of the Montana Department of Fish, Wildlife, and Parks. Forty three were subsequently recaptured by anglers or electrofishing. The specific location of capture was provided for 37 returns (Appendix Table 25). The reported locations of these recovered fish are shown in Figure 7. Most fish tagged on the primary study area and lower part of the secondary study area were either recaptured there or at scattered points around the reservoir. Fish tagged in the upper part of the secondary study

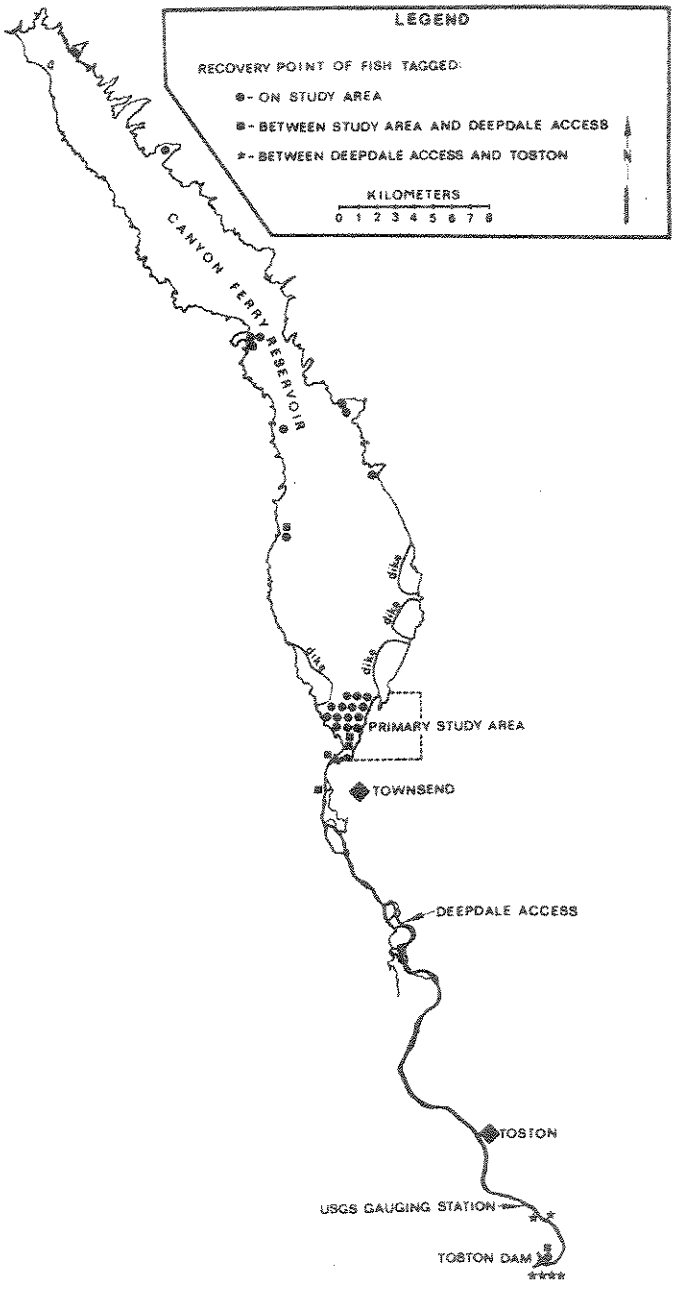

FIGURE 7. RECOVERY POINTS OF 37 RAINBOW TROUT TAGGED ON THE PRIMARY AND SECONDARY STUDY AREAS ON THE MISSOURI RIVER DURING 1978 AND 1979.

area (from Deepdale Access to Toston) tended to move upstream. High numbers of tag returns from the primary study area and Toston Dam probably reflect the areas of heaviest fishing pressure.

SUMMARY AND DISCUSSION

Almost 12,000 fisherman hours were expended and nearly 8,000 trout were harvested on the primary study area during the 1978 sampling season. Based on the average weight of 250 trout in the harvest the yield was estimated to be over 4.5 metric tons of trout from the area.

This is a fall fishery. September 9-November 17, 1978 comprised the second half of the sampling season and contained 88.5% of the total fishing pressure and produced 92.5% of the total harvest. The fall run composed mainly of two and three year old rainbow trout from the reservoir is responsible for sustaining the fishery. Canyon Ferry Reservoir is annually stocked with an average of 650,000 rainbow trout. The bulk of these are 10-15 cm long and raised from the eggs of brood stock which spawns in November and December. The fall run appears to be largely if not entirely made up of hatchery fish from this fall-spawning stock which could explain the reason for the fall run.

Runs of fall and winter-spawning rainbow trout are documented in McConaughy Reservoir, Nebraska (Van Velson 1974) and Bothwell's Creek, Lake Huron (Dodge and MacCrimmon 1971) respectively. In both cases the fall-winter run is self-sustaining and a normal spring run also occurs. However, most of the fish examined in the fall during this study appeared to lack the physiological development to spawn in the fall and there is no evidence of successful fall reproduction on the study area. It appears that at least some hatchery fish are also

attempting to spawn in the spring. An investigation should be conducted to determine the size of the spring spawning run in the Missouri.

The fall run in 1978 was apparently much stronger than in 1979. During 1979 the catch rates were lower in all sections and decreased overall by 29% (Table 6). The higher flows (Appendix Table 15) and lower water temperatures (Appendix Table 16) during the fall of 1978 may have provided a stronger stimulus for the fall run. Banks (1969) stated that most researchers feel flows are of primary importance in controlling salmonid migrations with temperature being one of several factors which could have a modifying effect. The onset of the run in 1978 apparently was closely correlated with a near doubling of flow and decreases of temperature in the river during September. In 1979 the discharge was lower than in 1978 and the flow surge was smaller and did not occur until late in October. The relationship between the lower flow regime during the second half of 1979 and the reduction in the fishery was most apparent in Section B. Because Section B was a smaller side-channel a reduction in flow apparently affected the fishing pressure and catch rates there more significantly than in the larger channels.

Marking the hatchery fish stocked in the reservoir with distinctive marks each year for several years would provide valuable information on the fall run. The age and growth characteristics, contribution to the

fishery, extent of upstream movement, and harvest rates of stocked fish both on the study area and in the reservoir could be determined from such a program.

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LITERATURE CITED

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APPENDIX

APPENDIX TABLE 15. MEAN DAILY DISCHARGES (CFS) AT THE U.S.G.S. GAUGING STATION AT TOSTON ON THE MISSOURI RIVER DURING 1978 CENSUS STRATA AND EQUIVALENT PERIODS OF 1979.

Stratum	Dates	1978	1979
1	7/1-7/14	9078	3621
2	7/15-7/28	5289	1800
3	7/29-8/11	2910	1732
4	8/12-8/25	2730	2235
5	8/26-9/8	3156	2735
6	9/9-9/22	5046	2383
7	9/23-10/6	5392	2374
8	10/7-10/20	5116	2729
9	10/21-11/3	5189	4103
10	11/4-11/17	4964	4416
Mean	7/1-11/17	4887	2813

APPENDIX TABLE 16. MEAN DAILY TEMPERATURE MAXIMUMS (°C) AT THE U.S.G.S. GAUGING STATION AT TOSTON ON THE MISSOURI RIVER DURING 1978 CENSUS STRATA AND EQUIVALENT PERIODS OF 1979.

Stratum	Dates	1978	1979
1	7/1-7/14	18.3	20.9
2	7/15-7/28	20.4	23.6
3	7/29-8/11	22.1	23.5
4	8/12-8/25	17.6	20.7
5	8/26-9/8	18.6	19.0
6	9/9-9/22	12.5	16.8
7	9/23-10/6	12.9	14.7
8	10/7-10/20	10.6	11.1
9	10/21-11/3	7.0	6.6
10	11/4-11/17	2.9	3.1
Mean	7/1-11/17	14.3	16.0

APPENDIX TABLE 17. COUNTS OF TOTAL NUMBERS OF FISHERMEN ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER MADE CONCURRENTLY FROM THE GROUND AND THE AIR DURING 1978.

Date	Time	Ground Count	Aerial Count	Ground Count as % of Aerial Count
9/21/78	11:00-11:50AM	11	14	78.6%
9/28/78	11:15-11:55AM	7	10	70.0%
10/4/78	11:45-12:20AM	12	16	75.0%
10/19/78	11:45-12:30AM	39	47	83.0%
Total		69	87	79.3%

APPENDIX TABLE 18. THE NUMBERS OF HOURS OVER WHICH FISHERMEN WERE COUNTED AND THE AVERAGE NUMBER OF DAYLIGHT HOURS PER DAY ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING 1978 STRATA.

Stratum	Date	Number of Hours Over Which Fishermen Were Counted		Average Number of Daylight Hours/Day
1	7/1-7/14	16	(6AM-9PM)	17
2	7/15-7/28	16	(6AM-9PM)	16
3	7/29-8/11	16	(6AM-9PM)	16
4	8/12-8/25	16	(6AM-9PM)	15
5	8/26-9/8	16	(6AM-9PM)	14
6	9/9-9/22	13	(7AM-7PM)	14
7	9/23-10/6	13	(7AM-7PM)	13
8	10/7-10/20	12	(7AM-6PM)	12
9	10/21-11/3	12	(7AM-6PM)	11
10	11/4-11/17	12	(7AM-6PM)	10

APPENDIX TABLE 19. THE ANGLING METHODS USED BY 1274 FISHERMEN AND PERCENTS OF THE TOTAL (IN PARENTHESES) ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING 1978.

Fishing Method	Section				Total
	A	B	C	D	
Bait	186	110	140	330	766 (60.1)
Fly	45	50	18	57	170 (13.3)
Lure	48	47	19	49	163 (12.8)
Combination	43	51	33	48	175 (13.7)

APPENDIX TABLE 20. DISTRIBUTION OF THE CATCH AMONG 904 ANGLERS WHO HAD COMPLETED FISHING AND PERCENTS OF THE TOTAL NUMBER OF ANGLERS (IN PARENTHESES) ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING 1978.

No. of Trout Kept	No. of Anglers
0	373 (41)
1	144 (16)
2	119 (13)
3	52 (6)
4	47 (5)
5	48 (5)
6	59 (7)
7	38 (4)
8	14 (2)
9	4 (<1)
10	6 (<1)
Total	904

APPENDIX TABLE 21. THE CATCH RATES (NUMBER/HR) OF TROUT HARVESTED AND RELEASED ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING 1978. ALL CATCH RATES WERE CALCULATED FROM TEN OR MORE INTERVIEWS.

Stratum	Dates	Section				Weighted Mean
		A	B	C	D	
1	7/1-7/14	0.29	-	-	-	0.21
2	7/15-7/28	0.53	-	-	-	0.48
3	7/29-8/11	0.04	-	-	-	0.47
4	8/12-8/25	1.38	1.02	-	-	1.15
5	8/26-9/8	2.02	1.42	-	1.21	1.29
6	9/9-9/22	1.42	1.66	2.39	0.79	1.23
7	9/23-10/6	1.07	1.30	0.86	1.33	1.22
8	10/7-10/20	0.82	0.62	0.86	1.53	1.15
9	10/21-11/3	0.76	0.77	0.97	1.14	0.98
10	11/4-11/17	0.52	-	0.82	0.75	0.67
Weighted Mean	7/1-11/17	0.89	1.07	0.95	1.26	1.11

APPENDIX TABLE 22. THE AVERAGE LENGTHS OF RAINBOW TROUT AND BROWN TROUT CREELED ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING 1978.

		Rainbow Trout			Brown Trout		
Stratum	Dates	No. Trout	Total No. Cm	Avg. Length (Cm)	No. Trout	Total No. Cm	Avg. Length (Cm)
1	7/1-7/14	2	36.8	18.4	1	35.3	35.3
2	7/15-7/28	5	119.9	24.0	0	0	0
3	7/29-8/11	4	80.8	20.2	0	0	0
4	8/12-8/25	20	438.5	21.9	6	168.3	28.0
5	8/26-9/8	106	3,081.6	29.1	15	464.9	31.0
6	9/9-9/22	136	4,781.4	35.2	22	706.1	32.1
7	9/23-10/6	326	12,479.0	38.3	17	616.2	36.2
8	10/7-10/20	244	9,532.8	39.1	8	310.3	38.8
9	10/21-11/3	144	5,767.9	40.1	0	0	0
10	11/4-11/17	57	2,225.5	39.0	1	52.5	52.5
Total	7/1-11/17	1,044	38,544.2	36.9	70	2,353.6	33.6

APPENDIX TABLE 23. THE AVERAGE LENGTHS OF RAINBOW TROUT AND BROWN TROUT CREELED ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING 1979.

Weekend-Holiday Period	Dates	Rainbow Trout			Brown Trout		
		No. Trout	Total No. Cm	Avg. Length (Cm)	No. Trout	Total No. Cm	Avg. Length (Cm)
1	8/25-9/21	65	2,568.0	39.5	2	70.7	35.4
2	9/22-10/19	166	5,733.1	34.5	6	241.5	40.2
3	10/20-11/16	71	2,710.5	38.2	4	117.4	29.4
Total	8/25-11/16	302	11,011.6	36.5	12	429.6	35.8

APPENDIX TABLE 24. SEX AND REPRODUCTIVE CONDITION OF 325 RAINBOW TROUT GREATER THAN 32 CM IN LENGTH HARVESTED ON THE PRIMARY STUDY AREA ON THE MISSOURI RIVER DURING 8/26-11/17 1978 AND 8/25-11/16 1979 (PERCENTS OF EACH SEX AND REPRODUCTIVE CONDITION FOR EACH YEAR ARE IN PARENTHESES).

Sex	Reproductive Condition	Numbers of Trout	
		1978	1979
Female	Low - Ova 29 mm in diameter or less	74 (76)	42 (86)
Female	Moderate - Ova 30-46 mm in diameter and adhering in a skein	20 (20)	7 (14)
Female	High - Recently spawned or with ova 30-46 mm in diameter and loose in body cavity	4 (4)	0 (0)
Male	Low - Testes were small translucent ribbons	46 (35)	14 (30)
Male	Moderate - Testes enlarged but not producing milt	71 (54)	29 (63)
Male	High - Milt extruded from mature testes when pressured	15 (11)	3 (7)

APPENDIX TABLE 25. THE LOCATIONS OF 37 RAINBOW TROUT TAGGED ON THE PRIMARY AND SECONDARY STUDY AREAS AND SUBSEQUENTLY RECOVERED ON THE MISSOURI RIVER DURING 1978 AND 1979.

Date Tagged	Location of Tagging	Date Recovered	Location Recovered	Elapsed Time (days)	Direction of Movement	Minimum Distance Traveled (km)
9/27/78	Toston to Deepdale	4/28/79	Big Springs below Toston Dam	213	Upstream	6
10/16/78	Toston to Deepdale	6/-/79	Toston Dam	228-258	Upstream	11
10/16/78	Toston to Deepdale	7/26/79	Toston Dam	283	Upstream	11
10/18/78	Section A	10/27/79	Toston Dam	374	Upstream	31
10/18/78	Sections A-C	4/25/79	Townsend Bridge	189	Upstream	0
10/18/78	Section A	10/25/78	Section A	7	None	0
10/18/78	Sections A-C	2/19/79	Can. Ferry Res. on west side	124	Downstream	17
10/18/78	Section C	10/23/78	Section D	5	Downstream	0
10/18/78	Section C	11/2/78	Section D	15	Downstream	0
10/18/78	Sections A-C	1/28/79	Can. Ferry Res. at Hellgate Bay	102	Downstream	33
10/18/78	Section C	8/25/79	Section D	311	Downstream	0
10/18/78	Sections A-C	10/-/78	Can. Ferry Res. at Duck Creek	1-13	Downstream	14
10/18/78	Sections A-C	4/18/79	Can. Ferry Res. at Magpie Bay	182	Downstream	41

APPENDIX TABLE 25. (CONTINUED)

Date Tagged	Location of Tagging	Date Recovered	Location Recovered	Elapsed Time (days)	Direction of Movement	Minimum Distance Traveled (km)
10/18/78	Section D	11/2/78	Section D	15	None	0
10/18/78	Section D	10/20/78	Section D	2	None	0
10/18/78	Section D	9/22/79	Section D	339	None	0
10/18/78	Section D	8/17/79	Can. Ferry Res. at Confederate Bay	303	Downstream	16
10/25/78	Sections A-C	5/-/79	Can. Ferry Res. at Confederate Bay	188-219	Downstream	17
10/25/78	Section B	11/1/78	Section D	7	Downstream	2
10/25/78	Section B	11/16/79	Section D	387	Downstream	1
10/25/78	Section A	2/4/79	Can. Ferry Res. at Silos	102	Downstream	12
10/25/78	Sections A-C	6/15/79	Section A	233	None	0
10/25/78	Section A	11/1/78	Section A	7	None	0
10/25/78	Sections A-C	5/27/79	Section A	214	None	0
10/25/78	Sections A-C	4/24/79	Can. Ferry Res. at Beaver Cr.	181	Downstream	22
10/25/78	Section C	1/19/79	Can. Ferry Res. at Beaver Cr.	86	Downstream	22
10/25/78	Section C	3/24/79	Can. Ferry Res. at Beaver Cr.	150	Downstream	22

APPENDIX TABLE 25. (CONTINUED)

Date Tagged	Location of Tagging	Date Recovered	Location Recovered	Elapsed Time (days)	Direction of Movement	Minimum Distance Traveled (km)
11/6/78	Deepdale to Townsend Bridge	10/1/79	Section A	329	Downstream	0
11/6/78	Deepdale to Townsend Bridge	4/22/79	Deepdale to Townsend Bridge	167	None	0
11/6/78	Deepdale to Townsend Bridge	3/31/79	Townsend Bridge	145	Downstream	0
11/6/78	Deepdale to Townsend Bridge	10/15/79	Toston Dam	343	Upstream	28
11/6/78	Deepdale to Townsend Bridge	9/26/79	Section D	324	Downstream	3
11/6/78	Deepdale to Townsend Bridge	7/1/79	Can. Ferry Res. at Silos	237	Downstream	13
3/20/79	Toston to Deepdale	6/-/79	Toston Dam	73-103	Upstream	11
3/20/79	Toston to Deepdale	4/7/79	Toston Dam	18	Upstream	11
3/21/79	Toston to Deepdale	5/8/79	Big Springs below Toston Dam	48	Upstream	6
4/13/79	Sections A-C	6/14/79	Townsend Bridge	62	Upstream	0