MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION

RESEARCH PROJECT SEGMENT

State of: Montana Name: Southwest Montana Fishery Study

Project No.: F-9-R-16 Title: Madison River Creel Census

Job No.: I(a)

Period Covered: August, 1965, to September, 1967

Abstract:

A creel census was conducted on 67 miles of the Madison River during portions of the years 1965, 1966, and 1967. Total angling pressure was computed for seven sections of the Madison River for the 1966 and 1967 census periods. In 1966, the total days fished was 32,812, and in 1967, it was 38,843. In the lower portion of the river (sections 1 and 2), the intensity of angler use was highest in May-June, while in the upper portion of the Madison, the highest intensity of use was in July.

Creel census data shows that the total catch per hour for 1965, 1966, and 1967 was consistently higher in the upper sections (3-7) than in the lower sections (1 and 2). There was little year-to-year variation in the total catch per hour within the same sections. Brown and wild rainbow trout were predominant in the catch in sections 1 and 2, while in sections 3-7, the hatchery rainbow was predominant. Bait fishing was the most common method of angling throughout the three census periods, although there were some seasonal changes in the method of angling. Angling by means of boats increased from 1966 to 1967. Nonresidents made up more than half of the total anglers during the three census periods, and they were the most numerous in the months of July and August. California and Utah supplied 44 to 75% of the nonresident anglers.

Recommendations:

Future creel census studies on the Madison River should include the following: (1) there should be at least six creel clerks to adequately sample the anglers in each section; (2) aerial counts should be made twice a day every other day during the census period; (3) on sections where ground counts can be made, the creel clerk should make hourly angler counts once every two weeks to compute angler pressure curves; (4) catch per hour should be computed at two-week intervals and by section of river; (5) creel census information should only include the actual data obtained by the creel clerk upon contacting the angler (contact data), as the information sent back by the angler after being contacted was generally exaggerated; and (6) sectioning of the river should take into account angler access points and points where hatchery trout are released.

Objectives:

The objectives of this study were to determine the fishing pressure on various sections; the catch rate of wild game fish and hatchery rainbow trout; the species composition of the catch; the residency of the angler; and the method of angling.

Techniques Used:

A creel census was conducted from August 1 to September 30, 1965; from May 22 to September 15, 1966; and from May 21 to September 15, 1967, on the portion of the Madison River between Greycliff and Quake Lake (Figure 1). The river was divided into eight sections to determine the relative angling pressure and catch rates on various portions.

Fishing pressure (total hours fished) for the entire river and individual sections was determined by the use of aerial angler counts and the daily angler pressure curve. The total number of angler-days was determined by dividing the average number of hours each angler fished per day into the total number of hours fished.

During the 1965 census period, periodic angler counts were made from an airplane on week days, weekends, and holidays, as well as at various times during the day. From these counts, a daily angler pressure curve was constructed (Figure 2). The total hours fished on a given day were considered to be the area under this pressure curve. Since the portion of the curve before 9:00 A.M. was concave and the portion after 5:00 P.M. was convex, the two "tails" compensate for each other and the pressure curve could be constructed as shown in Figure 3. Thus the area under the pressure curve (total hours fished) was estimated by multiplying the average instantaneous daily angler counts taken between 9:00 A.M. and 5:00 P.M. by 12 hours.

To compute an accurate estimate of total hours fished using the above method, an average instantaneous angler count between 9:00 A.M. and 5:00 P.M. must be determined. Each instantaneous count must include only those anglers actually fishing at that time. When aerial counts were made, it was possible to: (1) count an angler who was walking to the river; (2) count an angler who was walking back from the river; and (3) count an angler who started fishing prior to the count and continued after the count was made. If all three anglers were counted, the estimate would be high, as only the third type should have been counted. Since the person making these aerial counts could not differentiate between the three types of anglers, a correction must be made. The degree of correction was determined by using the average number of hours an angler fished per day (three hours) and the estimated time spent going to and from the river (0.5 hours). Since about 15% of an angler's time was spent going to and coming from the river, the instantaneous angler counts were reduced by 15%. This correction factor is similar to one computed from data on the Lawerence Creek creel census study (Hunt, 1964). In the Lawerence Creek study, an hourly distribution of anglers was plotted for the 1963 fishing season. This curve corresponds to the pressure curve in Figure 2. If the area under this curve is used as an estimate of hours fished, the total hours of fishing computed would be approximately 12% higher than actual tabulation of every angler using the census area. This indicates a need for correction of the instantaneous counts before computing the total hours fished from the pressure curve.

During the 1966 and 1967 creel census periods, aerial angler counts were made on every third day between 9:00 A.M. and 5:00 P.M. There were two counts per count day, one on the flight upstream and one on the flight downstream. Total hours of pressure were computed by the month and section. In computing total

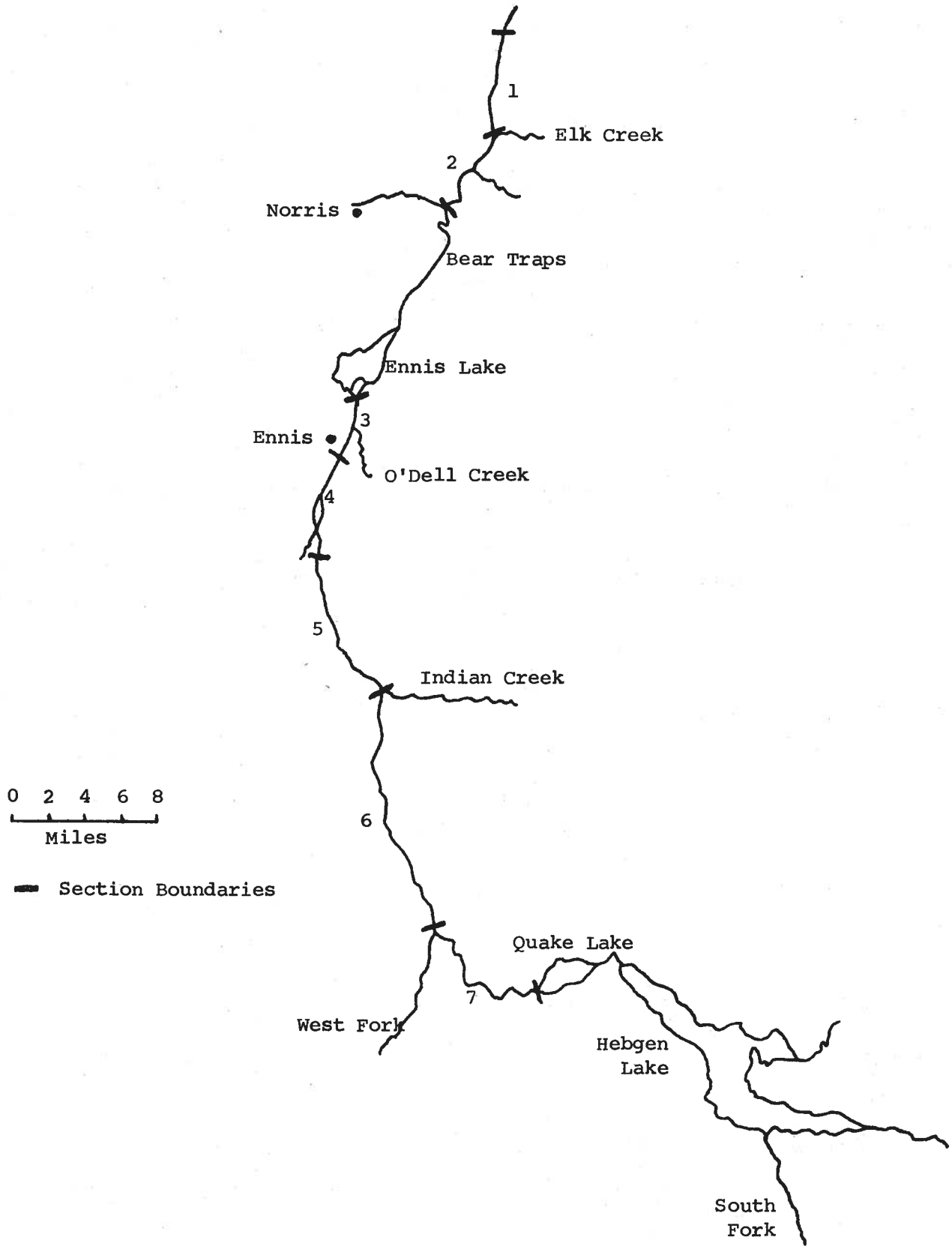

Figure 1. Map of the Madison River showing the creel census sections.

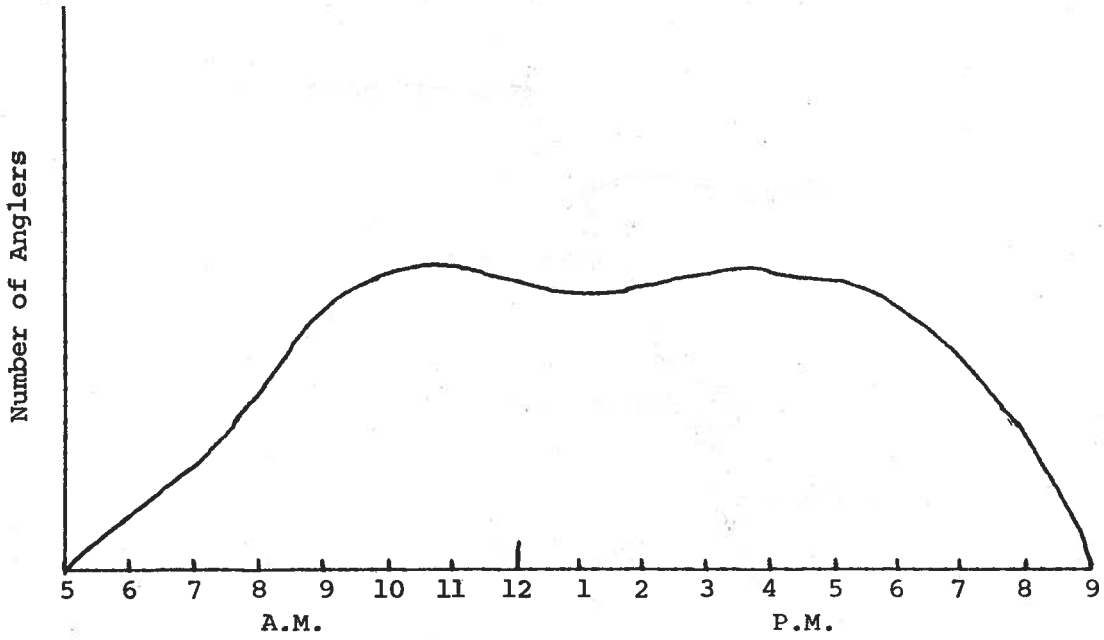

Figure 2. Daily angler pressure curve.

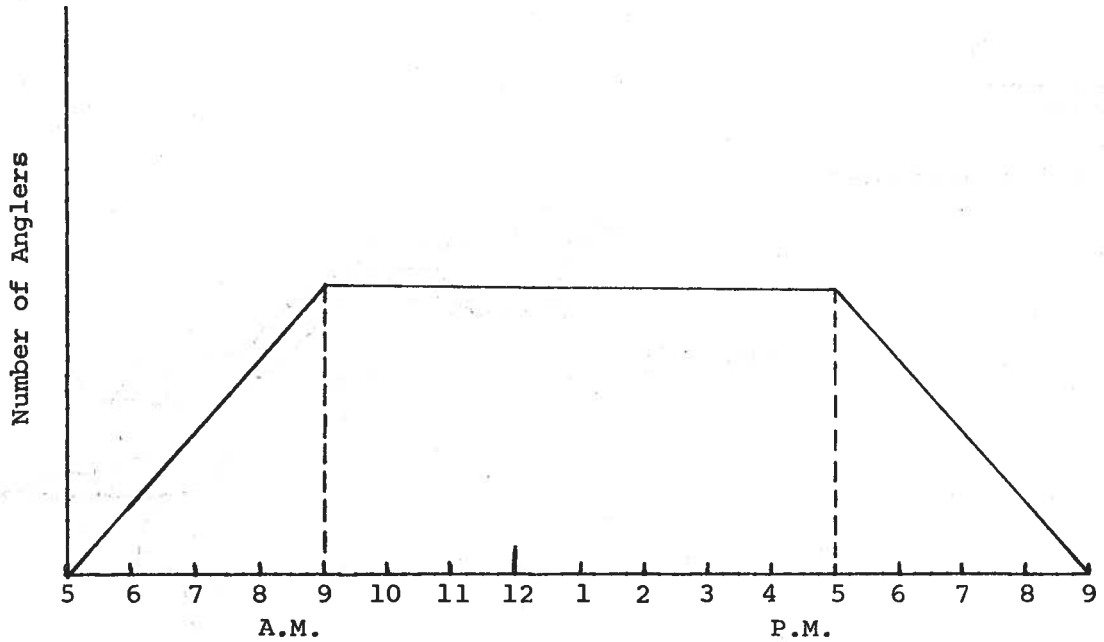

Figure 3. Adjusted angler pressure curve.

pressure for each month, the pressure for weekend days and holidays was computed separately from the week day pressure to give a more accurate pressure estimate. If pressure was computed for two-week intervals instead of by the month, then more aerial flights would be necessary to insure having at least one weekend count in each two-week period.

The ground creel census was conducted by a creel clerk who drove along the river contacting anglers during five days of each week with at least one of these days being a Saturday, Sunday or a holiday. The clerk censused either the entire river in one day or was assigned to several selected sections. The clerk obtained the following information from individual anglers: total hours fished, total number of each species caught, section of river fished, residence of angler, method of angling, and whether or not the angling had been completed for the day. If the angler had not completed the day's angling, then he or she was given a copy of the creel card to complete and return when the day's angling was completed. Thus the following types of data were collected: (1) contact complete - information taken from anglers who had finished angling when contacted by the creel clerk; (2) contact incomplete - information taken from anglers who had not completed the day's angling when contacted; and (3) voluntary - information filled out and returned by anglers who had not completed the day's angling when contacted by the creel clerk.

Findings:

Angling Pressure

Total hours fished and the number of angler-days were computed for seven sections (67 miles) of the Madison River. These sections varied in length from four to 17 miles. Table 1 gives a summary of the fishing pressure for each section during the 1966 and 1967 creel census periods. There was an 18% increase in total fishing pressure on the river from 1966 to 1967. The largest increases occurred in sections 2 (57%) and 4 (52%), while section 6 decreased 3%. Sections 6 and 7 had 47% of the total angling pressure on the Madison River in 1966 and 42% in 1967. When angling pressure was based on total hours per mile, then sections 3, 4 and 6 had the heaviest concentration of anglers in 1966 and sections 3, 4 and 2 in 1967.

The intensity of angler use on the river varies with the time of year. The portion of the Madison River below Ennis Lake (sections 1 and 2) shows the heaviest use in May-June and then a gradual decline through September (Figure 4). But the portion of the river above Ennis Lake (sections 3-7) had the heaviest use during July and then a steady decrease through September.

Creel Census Data

Creel census information was obtained from all seven sections of the Madison River. Certain sections received better coverage by the creel clerk than others. The degree of coverage was determined by the amount of access to the river in each section and whether or not the section was located along the main highway. Since a single creel clerk had to cover the entire 67 miles of river daily, only the readily accessible areas were censused regularly. This was done to obtain the maximum number of contacts possible.

Table 1. Fishing pressure in total hours and angler-days plus total hours and angler-days per mile for the seven sections of Madison River during the 1966 and 1967 creel census period. The 1967 data in parentheses

Section	Length	Total hours fished		Total angler-days		Hours/mile		Angler-days/mile	
1	4 mi.	1,746	(2,403)	546	(751)	437	(601)	137	(150)
2	6 mi.	7,079	(11,120)	2,212	(3,475)	1,180	(1,853)	369	(579)
3	5 mi.	16,911	(20,918)	5,285	(6,537)	3,382	(4,184)	1,057	(1,307)
4	9 mi.	15,550	(23,569)	4,859	(7,365)	1,722	(2,619)	540	(818)
5	11 mi.	14,187	(14,388)	4,433	(4,496)	1,290	(1,308)	403	(409)
6	17 mi.	26,633	(25,843)	8,323	(8,076)	1,567	(1,520)	490	(475)
7	15 mi.	22,893	(26,057)	7,154	(8,143)	1,526	(1,737)	477	(543)
Total	67 mi.	104,999	(124,298)	32,812	(38,843)	1,567	(1,855)	490	(580)

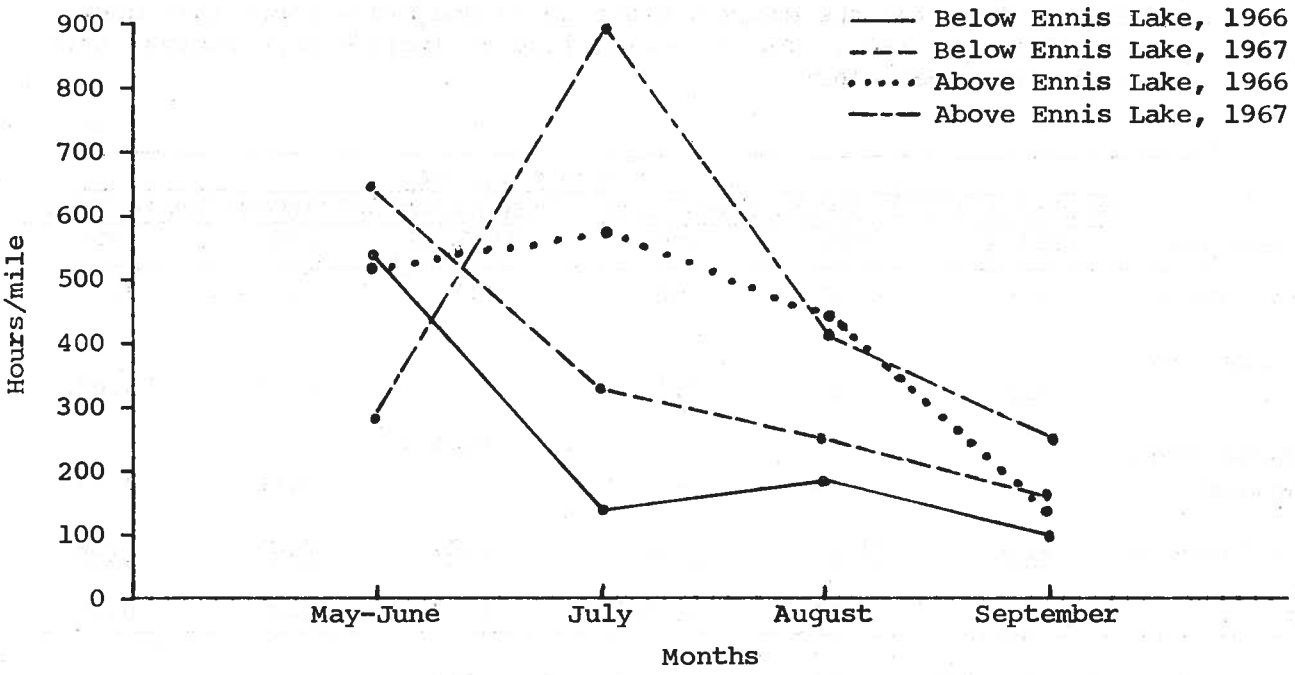

Figure 4. Fishing pressure in hours/mile for each month above (sections 1 and 2) and below (sections 3-7) Ennis Lake for the 1966 and 1967 creel census period.

During the 1966 census period, the creel clerk obtained 4,496.6 hours of contact information. This comprised a 4.3% sample based on the total hours fished during the period. In 1967 the creel clerk obtained 3,043.5 hours of contact data, which was a 2.4% sample based on the total hours fished. This low percentage of contacts plus the censusing of only access areas tends to make the accuracy of the catch per hour data questionable.

The average amount of time each angler fished per day was computed from data obtained from anglers who had completed their angling when contacted by the creel clerk. The average number of hours fished per day was 3.7, 3.3, and 3.2 in 1965, 1966, and 1967, respectively.

Catch per hour was computed for two regions of the Madison River - below Ennis Lake (sections 1 and 2), and above Ennis Lake (sections 3-7). Table 2 shows a summary of the catch per hour data for 1965, 1966, and 1967, computed from the contact data. The catch for each species was computed by dividing the total number of that species caught by the total hours fished. The volunteer information was not included in this table because the catch per hour rates computed from this data were up to 72% higher than the rates computed from the contact data. Anglers probably tend to overestimate their daily catch, and many are uncertain in the identification of the species caught. Also, successful anglers are probably more inclined to return the form than are the unsuccessful anglers.

Table 2. Catch per hour for the Madison River above and below Ennis Lake during 1965, 1966, and 1967. The following figures include only contact data supplied by creel clerk

Species	Catch per hour					
	Sections 1 & 2 (below Ennis Lake)			Sections 3-7 (above Ennis Lake)		
	1965 1/	1966	1967	1965 1/	1966	1967
Brown Trout	0.13	0.17	0.20	0.26	0.20	0.19
Rainbow Trout (wild)	0.19	0.30	0.17		0.17	0.02
Rainbow Trout (hatchery)	-	-	-	0.34 2/	0.56	0.63
Other Species	0.10	0.07	0.16	0.21	0.07	0.06
Total	0.41	0.54	0.53	0.81	1.00	0.90

1/ 1965 data is only for the months of August and September.

2/ Catch per hour data for wild rainbow and hatchery rainbow in 1965 was not separated.

The catch per hour remained relatively constant within each of the two major regions of the river during the three years of the creel census study. The overall catch rate was higher in the upper region during the period of study, but the rate of wild fish was lower.

Species composition of the catch was determined from contact data obtained by the creel clerk. Table 3 gives a summary of the species composition of the catch for the three creel census periods. Wild brown and rainbow trout were the predominant species in the catch in the lower region, while hatchery rainbow made up over half of the catch in the upper.

Method of angling. The major methods of angling reported by anglers on the creel census forms were: (1) bait, (2) artificial lures, (3) flies, and (4) combination. The fourth method (combination) included those anglers who used two or more of the first three methods. Bait fishermen were the most common type of angler on all sections of the Madison River during the periods of study, but the lower region did have proportionately more bait fishermen than the upper region (Table 4).

Table 3. Species composition of the catch for the Madison River above and below Ennis Lake during 1965, 1966, and 1967. Figures given in percent of total catch

Species	Percent Composition					
	Sections 1 & 2 (below Ennis Lake)			Sections 3-7 (above Ennis Lake)		
	1965 1/	1966	1967	1965 1/	1966	1967
Brown Trout	31	27	55	31	21	16
Rainbow Trout (wild)	45	46	26		17	13
Rainbow Trout (hatchery)	-	-	-	40 2/	59	66
Other Species	24	27	19	29	3	5

1/ 1965 data is only for the months of August and September.

2/ Data for wild and hatchery rainbow in 1965 was not separated.

Table 4. Relative use of angling methods in 1965, 1966, and 1967 creel census periods. The figures are given in percent of total fishermen using each method

Method of Angling	Percent Composition					
	Sections 1 & 2 (below Ennis Lake)			Sections 3-7 (above Ennis Lake)		
	1965	1966	1967	1965	1966	1967
Bait	41	37	44	27	37	39
Lures	21	19	19	13	18	16
Flies	8	13	15	35	19	28
Combination	30	31	22	25	26	17

There was a general decline in bait fishermen from May through September, while the fly fishermen showed a gradual increase (Figure 5). Most of the bait fishing occurs in the spring (May-June) when the river is high and turbid due to runoff from melting snow. Fly and lure fishing increased when the river became lower and less turbid. There appears to be more fly fishing in the upper region of the river (above Ennis Lake) than in the lower region (below Ennis Lake).

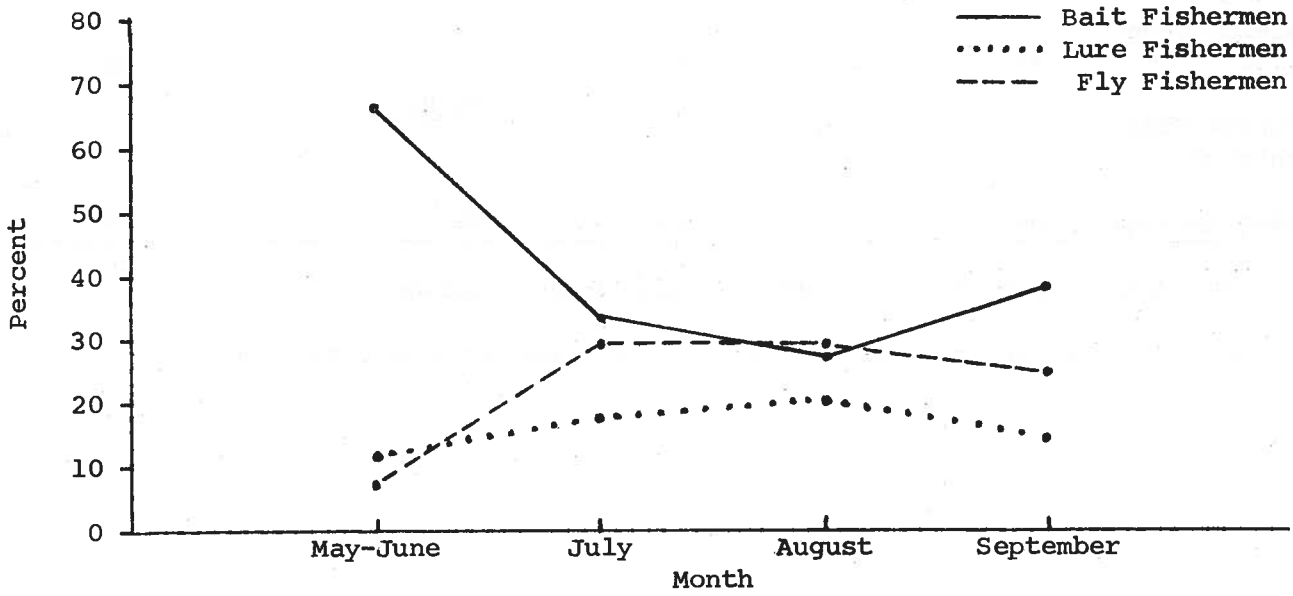

Figure 5. Relative abundance of the three types of fishermen by month for the 1967 creel census period on the Madison River. Data is given in percent of total fishermen contacted each month.

Boat usage. Angling from a floating boat was legal on sections 1 through 4 of the Madison River. Using the aerial counts made during 1966 and 1967, it was possible to compare the relative boat usage per section for these two years. This data indicates that there was a substantial increase in boat usage on sections 2, 3, and 4. In 1966, the number of boats per aerial count for sections 2, 3, and 4 was 0.1, 0.7, and 2.2, respectively; while in 1967, the count was 0.2, 3.6, and 6.1, respectively.

Residency of angler. As indicated under Techniques Used, the residency of individual anglers was recorded by the creel clerk. The ratio of resident to nonresident anglers varied with the section of the river and the month. In the fishing season as a whole, there were more nonresident than resident fishermen above Ennis. Below Ennis, resident fishermen predominated (Table 5). Residents usually outnumber nonresidents in the early part of the census period (May-June), but as the season progresses, the nonresident portion increases until they made

Table 5. Percent composition of resident and nonresident fishermen for the 1965, 1966, and 1967 creel census periods

Section	1965 1/	1966	1967
1 and 2			
Resident	76	80	69
Nonresident	24	20	31
3-7			
Resident	33	43	34
Nonresident	67	57	66
Total			
Resident	40	48	40
Nonresident	60	52	60

1/ 1965 data includes only the months of August and September.

60-70% of the anglers using the river. The number and proportion of nonresidents using the river rapidly declines in September when about 50% of the anglers are residents.

The nonresidents come from 38 states, Canada, and Puerto Rico. Using data from Tables 1 and 5, the total number of nonresident angler-days was computed as follows: 1966 - 17,633, and 1967 - 23,306. Table 6 shows the relative distribution and total number of nonresident anglers for the 1965, 1966, and 1967 census periods. The states of California and Utah comprise 44 to 75% of the nonresident anglers during the three years. There was a steady decline in the relative abundance and total number of Utah fishermen from 1965 through 1967. There was a substantial increase in the number of California anglers. The number of anglers from the other three states listed in the table has stayed the same or slightly increased. The overall increase in nonresident anglers was probably due to an increase in anglers from other states.

Discussion:

One of the most important aspects in setting up a creel census on a larger river is proper sectioning of the stream to insure accurate sampling of anglers and angler harvest. Sectioning of the river would not be too important if access, fish population density, and species composition were uniform throughout the census area, but this is usually not the case. For example, hatchery trout, which are comparatively easy to catch, tend to remain around areas where they were stocked, so areas away from points of release tend to have few hatchery trout. Thus distribution is not uniform. Then if the creel clerk censuses only anglers around these access points, as occurred in the present study, the computed catch per hour recorded is much higher than it actually is for the river as a whole.

Table 6. Relative abundance and total numbers of nonresident anglers for the 1965, 1966, and 1967 creel census periods. Figures are given in percent of total nonresidents for each year. Estimated number of nonresidents in parentheses

State	1965 1/	1966		1967	
California	30	21	(3,608)	30	(6,992)
Colorado	5	4	(5,465)	7	(3,262)
Idaho	4	6	(706)	4	(1,631)
Utah	45	31	(1,060)	14	(932)
Washington	3	9	(1,590)	5	(1,165)
Other	5	29	(5,233)	40	(9,324)

1/ 1965 data is only for the months of August and September.

This also causes an overestimate in the harvest of hatchery trout. To overcome this bias, sections should be set up so the areas around the access sites would be separate from those areas which receive fewer hatchery fish. Catch per hour and angling pressure could then be computed for each section and a meaningful harvest could be determined.

Another factor causing biased harvest and catch per hour data is when catch rates are estimated for large time intervals. Catch rates, angling pressure, and species composition of the catch varies considerably with the time of year. The shorter the time interval, the greater the chance of picking up changes in these rates. For example, if for a given month time period, the catch rate was 0.60 and the angling pressure 10,000 hours. Now if this period was broken into two-week periods, the catch rate was 0.40 and 0.80 with the pressure 3,000 and 7,000 hours, respectively. When the harvest was computed for the month, it would be 6,000 fish, but when using two-week intervals, the harvest was 1,200 and 5,600, or a total of 6,800.

Hunt, Robert L. 1964. Effects of angling regulations on a wild brook trout fishery. Annual Progress Report. Lawerence Creek Trout Research Project.

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Date: January 2, 1969

Waters referred to: Madison River 13-3440-1