

MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

FISHERIES DIVISION

JOB PROGRESS REPORT

State: Montana Title: Southwest Montana Fisheries Investigation
Project No.: F-9-R-32 Title: Madison River Temperature Study
Job No.: II-b
Project Period: July 1, 1983 through June 30, 1984
Report Period: July 1, 1983 through June 30, 1984

ABSTRACT

Comparison of water temperature data above and below Ennis Reservoir shows the average June to August water temperatures to be 7.1°F and 7.8°F warmer at the Norris Bridge than at the Varney Bridge for 1982 and 1983, respectively. Comparisons of the number of wild brown and rainbow trout between the Varney and Norris study sections show the Varney section has 35% more 16-inch and larger trout in 1982, and 23% in 1983. This difference could be due to the high water temperature found in the Norris section which could be reducing trout growth rates.

BACKGROUND

The Madison River is formed by the Gibbon and Firehole rivers in Yellowstone National Park and flows in a northerly direction to join the Jefferson and Gallatin rivers to form the Missouri River at Three Forks. Two major reservoirs were built on the Madison River--Hebgen, which is located 1.5 miles west of Yellowstone National Park, and Ennis, which is located seven miles north of the town of Ennis.

In 1900, the Madison Dam at Ennis was constructed to provide electrical power for southwestern Montana. Since Ennis Reservoir is located in a naturally shallow basin with a small dam, the reservoir itself is very shallow with an average depth of less than nine feet. This shallow reservoir has led to some warming of the Madison River below the dam which endangers the "Blue Ribbon" trout fisheries in the last 35 miles of the river. There has been

periodic fish kills in this area in the last 25 years which may have been caused by the warmer water. In 1961, a Montana Department of Fish and Game study showed the Madison River was 10 to 15°F warmer below the reservoir than above (Heaton 1962).

OBJECTIVES AND DEGREE OF ATTAINMENT

1. To determine if higher water temperatures below Ennis Reservoir are having detrimental effects on wild trout populations through changes in age structure, size composition, species composition and growth rates (data included in report).
2. To obtain wild trout population estimates to include age structure, size composition, species composition and condition factors (data included in report).
3. To gather water temperature data above and below Ennis Reservoir from April through September (data included in report).
4. To determine if a correlation exists between water temperatures and growth rates from the April through September period (data will be included in a future report).

PROCEDURES

Electrofishing gear was used to sample fish populations in two sections of the Madison River (Norris and Varney). Electrofishing was carried out while floating through the section in a fiberglass boat. Population estimates were made using the Peterson-type mark-and-recapture method. Two or more "marking" and/or "recapture" trips were necessary where sample sizes were small and/or efficiencies were low. Usually a 10- to 14-day period was allowed between marking and recapture trips. Scales were taken to determine age and growth rates. Actual mathematical computations were made by a computer program using methods described by Vincent (1971; 1974).

Two thermographs were set up on the Madison River as follows: (1) Varney Bridge--at the USGS gauging station near Varney Bridge, and (2) at Norris Bridge (Figure 1). Thermographs recorded water temperatures from March 1, 1982 through September 30, 1982 and from March 1, 1983 through September 30, 1983.

FINDINGS

Comparison of water temperatures above (Varney) and below (Norris) Ennis

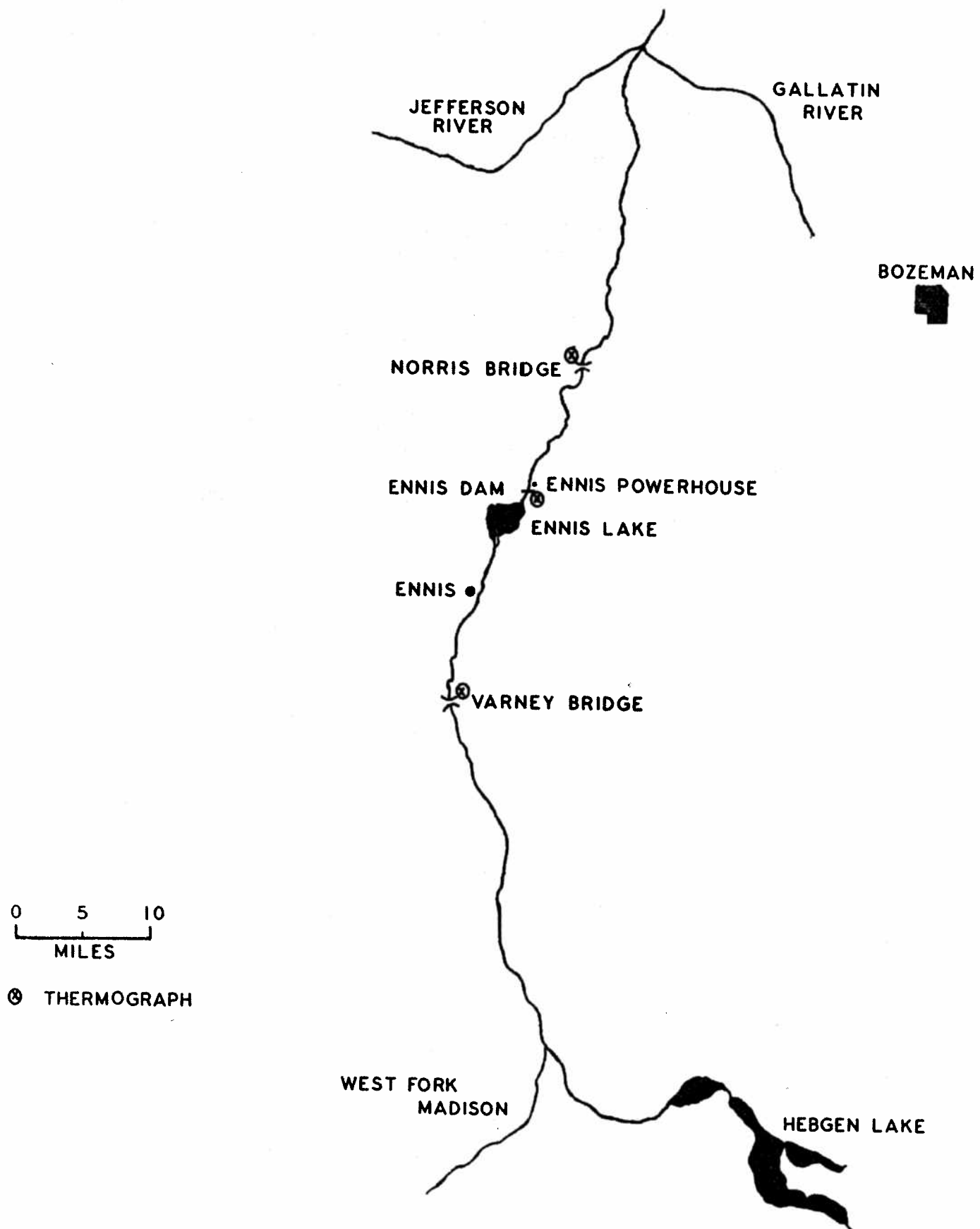


FIGURE 1. Map of Madison River

Reservoir for the years 1982 and 1983 show the average temperature for the June through August period (principle growth period for wild trout) in the Norris section to be 7.1°F and 7.8°F higher, respectively, than found in the Varney section (Table 1). Part of this increase is probably due to the warming influence of Ennis Reservoir. Most of the difference in water temperature is due to an increase in the average minimum water temperatures from Varney to Norris, as average minimum temperatures in the Norris section for this period were 8.3° and 9.1°F higher, respectively.

Age and growth data from the Norris study section (1978-1981) showed some relationship between growth rates (length) and the average water temperature for the June through August period where cooler water has better growth rates (Vincent 1983). Since the June through August average water temperature in the Norris section is higher than found in the Varney section, it could account for the lower number of larger (16-inch and larger) brown and rainbow trout found in the Norris section (Table 2).

Wild brown and rainbow trout age structure for the Varney section in 1982 and 1983 shows an increase in the number of three-year-old and older brown trout (Table 3). At this time it is not certain what factors cause these changes within the Varney study section.

Table 1. Comparison of the 1982 and 1983 average maximum, minimum and mean water temperatures for the March through September period at the Varney and Norris thermograph stations (expressed in degrees F).

Month	VARNEY			NORRIS		
	Avg. Max	Avg. Min.	Mean	Avg. Max.	Avg. Min.	Mean
<u>1982</u>						
March	42.7	35.7	39.2	40.4	34.7	37.6
April	46.3	36.4	41.4	45.5	39.3	42.4
May	51.1	41.7	46.4	56.0	48.9	52.5
June	54.6	47.1	50.9	60.8	55.4	58.1
July	62.0	53.4	57.7	68.6	62.7	65.7
August	65.6	56.8	61.2	70.5	64.1	67.3
September	57.7	50.9	54.3	59.3	55.0	57.2
<u>1983</u>						
March	--	--	-- ¹	44.0	37.5	40.8
April	--	--	-- ¹	50.8	41.3	46.1
May	53.1	41.0	47.1	56.6	48.5	52.6
June	55.0	47.0	51.0	62.2	56.8	59.5
July	61.8	52.7	57.3	67.4	61.7	64.6
August	66.4	57.6	62.0	73.8	65.9	69.9
September	56.4	50.6	53.5	60.6	54.7	57.7

¹ No data available.

Table 2. Comparison of various size groups of wild brown and rainbow trout between the Varney and Norris study sections on the Madison River for 1982 and 1983. (Population estimates for the Varney section were made in September and in April for the Norris section; confidence intervals at the 80% level are shown in parentheses; both sections are 4 miles long).

Size Group (in.)	--- Rainbow Trout ---		--- Brown Trout ---	
	Varney	Norris	Varney	Norris
<u>1982</u>				
5.0 - 9.9	4 256	7 567	6 533	1 631
10.0 - 12.9	1 474	5 731	1 461	4 059
13.0 - 15.9	525	1 439	1 876	1 919
16.0 - Larger	<u>47</u>	<u>35</u>	<u>1 263</u>	<u>842</u>
Total	6 302 (+ 2324)	14 772 (+ 2044)	11 133 (+ 1360)	8 451 (+ 1487)
<u>1983</u>				
5.0 - 9.9	4 701	2 898	7 452	4 889
10.0 - 12.9	1 336	5 077	1 895	1 708
13.0 - 15.9	1 178	981	1 359	2 219
16.0 - Larger	<u>148</u>	<u>15</u>	<u>949</u>	<u>866</u>
Total	7 363 (+ 3266)	8 971 (+ 1206)	11 655 (+ 1117)	9 682 (+ 1615)

Table 3. Wild brown and rainbow trout estimates for age groups, total number and total biomass for the Varney section of the Madison River for September, 1982 and 1983 (confidence intervals at the 80% level shown in parentheses).

Age Group	----- 1982 -----		----- 1983 -----	
	Rainbow Trout	Brown Trout	Rainbow Trout	Brown Trout
I	4 049	6 228	4 543	7 046
II	1 353	1 623	1 113	2 176
III	560	1 299	1 049	1 079
IV+	340	1 983	658	1 354
Total No.	6 302 (+ 2324)	11 133 (+ 1360)	7 363 (+ 3266)	11 655 (+ 1117)
Total Wt (lbs)	2 259 (+ 559)	6 613 (+ 875)	2 969 (+ 669)	5 789 (+ 558)

LITERATURE CITED

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Waters Referred To: Madison River, 13-
3440-01; Ennis Res-
ervoir