F-9-R-30 IIc
Region 3
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MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

FISHERIES DIVISION

JOB PROGRESS REPORT

State: Montana Title: Southwest Montana Fisheries Investigation

Project No.: F-9-R-30

Job No.: IIc Title: Fishing Regulation Evaluation on Major Trout Waters

Period Covered: July 1, 1981 through June 30, 1982

ABSTRACT

Two study sections, Pine Butte and Snoball, were established on the Madison River between 6.0 and 10.0 miles below Quake Lake to determine the effect of heavy angling pressure on wild trout populations. The Pine Butte section was open to catch-and-release fishing with artificial lures and flies only; the Snoball section remained closed to all fishing. After five years of fishing closure, the Snoball section showed a 219% increase in numbers and a 162% increase in biomass of III+ rainbow and brown trout. After four years of catch-and-release fishing in the Pine Butte section, the number of III+ trout increased 238% in number and 217% in biomass. The total summer mortality for wild rainbow trout was higher in the catch-and-release section for the 1978-80 period (48%) than for the closed section (27%). Angling pressure in the catch-and-release section increased 80% over the first year under catch-and-release only; however, the catch rate decreased from 1.37 trout per hour to 0.90 trout per hour.

Two study sections were established on the Gallatin River between the mouth of the West Fork and Moose Creek to compare the effect of the special trout limit: three trout under 13 inches and one over 22 inches to the regular limit; five trout--one over 18 inches. The regular limit resulted in a higher summer loss of IV+ rainbow trout (54%) than did the special limit. The number of 13-inch and larger rainbow trout decreased 42% from March to October 1981 in the regular limit section versus a 8% increase in the special limit section.

BACKGROUND

The Madison River is a nationally-known "blue ribbon" wild trout stream that over the years has received a steady increase in angler use. Studies beginning in 1952 (USFWS, 1951) and again in 1967 (Vincent, 1969) show that angling pressure had increased about 14.3% annually during the 15-year period. Mail surveys conducted by the Montana Department of Fish and Game in 1975 estimated a 5% annual increase in angling pressure from 1967 through 1975. This large increase in angling use of 215 angler days in 1952 to 953 angler days per mile in 1975--could have had a detrimental effect on the wild trout population in both numbers and size available to future anglers. Also, there has been considerable controversy as to whether or not fishing from floating craft has a detrimental effect on the wild trout populations.

OBJECTIVES AND DEGREE OF ATTAINMENT

To determine the effect of angling on total numbers, size, composition, species composition, age composition, and total mortality rates in wild trout populations in one section of the Madison River and two sections in the Gallatin River.

To monitor the status of wild trout populations in a "closed to fishing" section of the Madison River and compare the "open to fishing" years.

These objectives were met. Data is presented in this report.

PROCEDURES

Electrofishing gear was used to sample fish populations in the Snoball and Pine Butte sections of the Madison River and the Smith Bridge and Durnam Bridge sections of the Gallatin River. Population estimates were made in March-April prior to the opening day of fishing season and again in September-October after most of the angling pressure ceased. The electrofishing was carried out while floating through the section in a fiberglass boat using the mobile positive electrode system. Two or more "marking" and/or "recapture" trips were necessary where samples were small and/or efficiencies were low. Scale samples were taken for age determination--actual mathematical computations were made using a computer program employing methods described by Vincent (1971 and 1974).

An intensive creel census was conducted on the Pine Butte section (3.0 miles) of the Madison River from May 16, 1981 to September, 1981. Creel checks and angler counts were made to determine catch rates and angling pressure by age, size and species. Computations of creel census data was done using a computer program employing methods described by Neuhold and Lee (1957).

On the Madison River, the Pine Butte study section (3.0 miles in length) is located about six miles downstream from Quake Lake, while the Snoball section (4.5 miles in length) begins about one mile downstream from the end of the Pine Butte section (Figure 1). On the Gallatin River, the Jack Smith Bridge section (2.2 miles in length) is located about two miles downstream from the West Fork, while the Durnam Bridge section (2.0 miles in length) is located about 2.6 miles below the end of the Jack Smith Bridge section (see Figure 2).

FINDINGS

Madison River

Wild trout population studies conducted on the upper Madison River (Snoball Study section) during 1975 and 1976 showed unusually high summer losses of larger (III+) brown and rainbow trout (Vincent, 1977). Angling regulations on the Madison River for 1975 and 1976 allowed a daily creel limit of 10 trout or 10 pounds and one trout. Creel census data from this study section showed summer (May-September) catch rates averaging 2.73 trout per hour in 1975 and 1.23 trout per hour in 1976. Angling pressure ranged from 720 to 1750 hours per mile for the two years. Given the high catch rates, angling pressure and summer mortality, the Snoball study section was closed to fishing beginning with the 1977 fishing season. In addition, a second study section (Pine Butte) was established in 1977 as a control (open to fishing under the 10 trout limit). After a one year fishing closure on the Snoball section, the high summer losses of older rainbow trout (75%) lowered to 18% (Vincent, 1979). Summer losses in the 10 trout limit area (Pine Butte) remained high on large wild rainbow trout (71%). With this information, angling regulations on the Pine Butte study section were changed from the 10 trout or 10 pounds, one trout creel limit to catch-and-release artificial lure only fishing beginning with the 1978 fishing season.

Estimates of age structure, total number, and total biomass for wild brown and rainbow trout in the closed-to-fishing section (Snoball) for 1980 and 1981 are shown in Table 1. After five years of fishing closure (1977 to 1981), the number of III+ brown and rainbow trout increased 219% with biomass increasing 162% (see Table 2). The number of rainbow trout exceeding 13 inches (one pound) increased 181% with three years of fishing closure, but showed some decline in the 1979 levels during 1980 and 1981 (see Table 3). Brown trout (13 inches and longer) showed a similar increase by 1979, a slight decrease in 1980, and an increase in 1981.

Estimates of age structure, total number, and total biomass for brown and rainbow trout in the catch-and-release only study section (Pine Butte) are shown in Table 4. After four years of catch-and-release only fishing, the number of III+ trout increased 238% and the total biomass increased 217% (Table 5). By 1981 the number of rainbow trout exceeding the 13 inches increased 230%, while brown trout increased 92% (see Table 6).

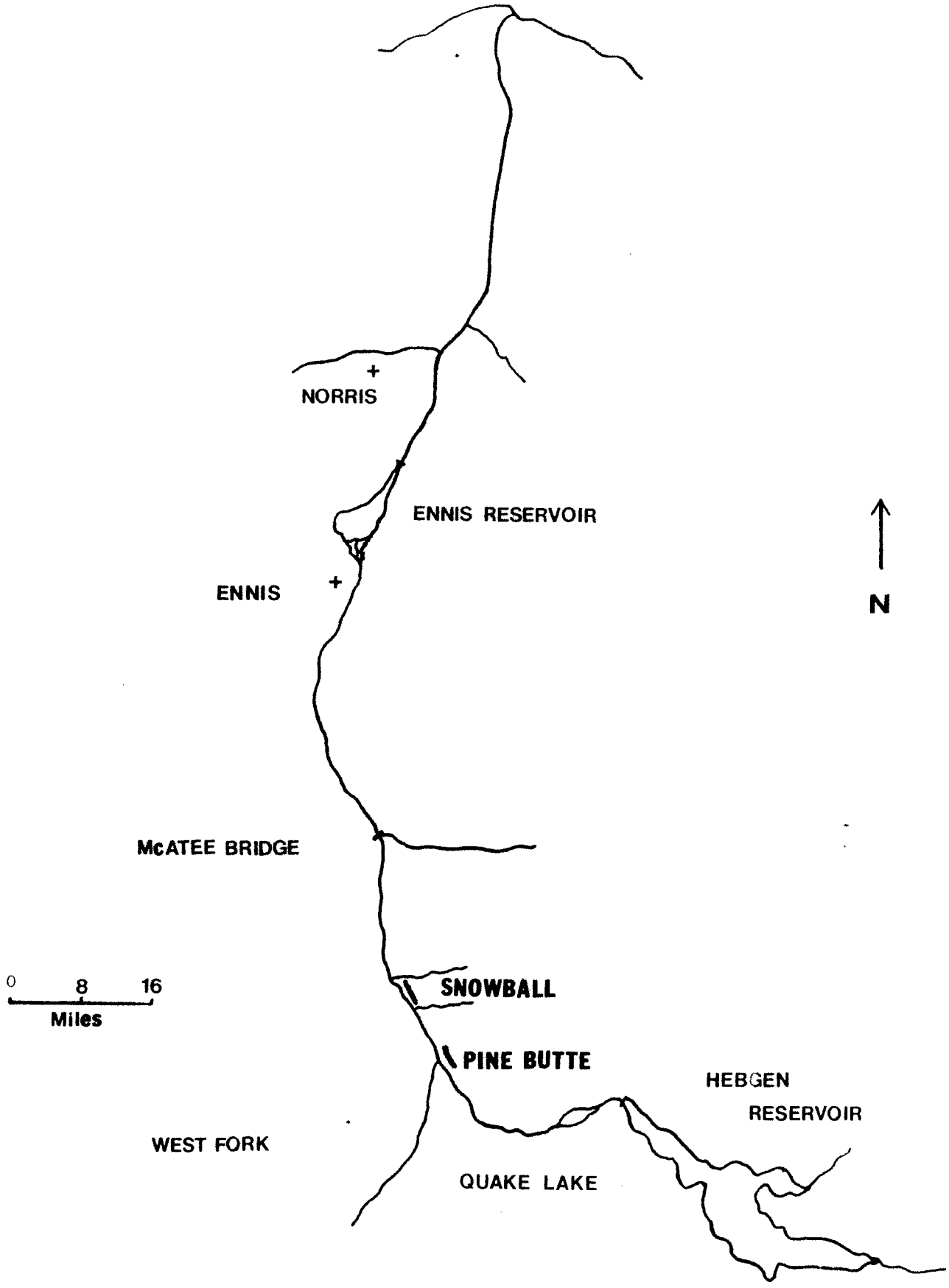

FIGURE 1. Map of the Madison River showing study sections.

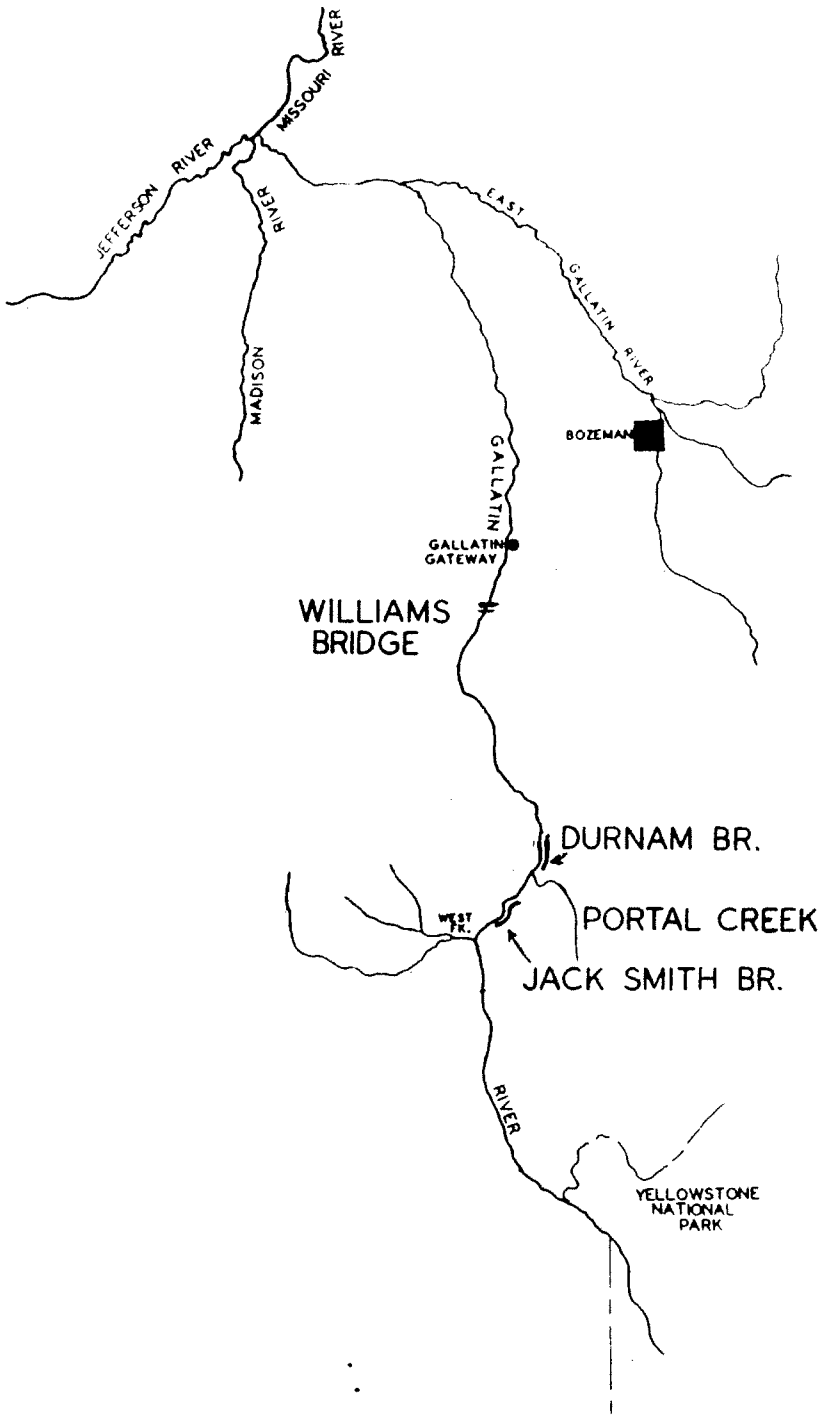

FIGURE 2. Map of the Gallatin River showing study sections.

Table 1. Wild brown and rainbow trout population, biomass, and age structure estimates for the Snoball section of the Madison River for 1980 and 1981 (80% confidence intervals in parentheses; section length is 4.5 miles).

Age Group	1980 Spring Estimate (March)	1980 Fall Estimate (Sept)	1981 Spring Estimate (March)	1981 Fall Estimate (Sept)
RAINBOW TROUT				
I	--[1]	5 178	--[1]	7 568
II	--[2]	1 883	--[2]	1 533
III	1 340	1 048	1 232	875
IV	1 858	1 489	808	750
V+	2 779	1 779	2 080	1 593
Total No.	5 977 (±942)	11 377 (±2151)	4 120 (±546)	12 319 (±2811)
Total Wt. (lbs)	4 498 (±847)	4 292 (± 723)	2 806 (±406)	3 919 (± 590)
BROWN TROUT				
I	--[1]	1 129	--[1]	2 903
II	823	974	--[2]	739
III	562	630	1 262	759
IV+	957	506	890	653
Total No.	2 342 (±498)	3 239 (±539)	2 152 (±447)	5 054 (±960)
Total Wt. (lbs)	1 606 (±333)	1 825 (±321)	1 623 (±368)	2 447 (±390)

[1] No spring estimate for yearling rainbow and brown trout.

[2] No reliable spring estimate available.

Table 2. Comparison of brown and rainbow trout numbers and biomass in the Snoball section from September 1975 to September, 1981 (all trout III+).

The section was open to fishing in 1975 and 1976 (10 trout or 10 lbs and 1 trout limit), then closed to fishing from 1977 through 1981.

Year	SEPT Population Estimate	SEPT Total Biomass Estimate (lbs)	% Change from Sept, 1976 Numbers	Biomass
1976	1 451	1 520	--	--
1977	3 817	3 807	+ 163	150
1978	5 515	4 966	+ 281	227
1979	6 601	6 245	+ 355	311
1980	5 552	4 350	+ 283	186
1981	4 630	3 986	+ 219	162

Table 3. Comparison of the number of brown and rainbow trout over 13 inches in the Snoball section, pre-1975/76 and post closure to fishing (1977/81) (numbers shown in trout-per-mile).

Species	1975[1]	1976[1]	1977[2]	1978[2]	1979[2]	1980[2]	1981[2]
Rainbow	187	130	269	318	525	502	368
Brown	54	60	117	306	303	199	241
Total:	241 (±80)	190 (± 56)	376 -(± 105)	624 (±175)	827 (± 278)	701 (±153)	609 (± 101)

[1] 10 trout or 10 lbs, one trout limit.

[2] Closed to fishing.

Table 4. Wild brown and rainbow trout population, biomass, and age structure estimates for the Pine Butte section of the Madison River for 1980 and 1981 (80% confidence intervals in parentheses; section length is 3.0 miles).

Age Group	1980 Spring Estimate (March)	1980 Fall Estimate (Sept)	1981 Spring Estimate[1] (March)	1981 Fall Estimate (Sept)
RAINBOW TROUT				
I	--[2]	4 442	--[2]	4 385
II	2 582	1 342	1 654	1 562
III	3 077	1 884	--	1 262
IV	1 875	979	--	1 559
VI+	749	245	--	653
Total No.	8 283 (±1003)	8 892 (±1579)	1 654 (±390)	9 441 (±1302)
Total Wt (lbs)	4 478 (± 560)	3 460 (± 613)	590 (± 99)	3 776 (± 536)
BROWN TROUT				
I	--[2]	1 677	--[2]	1 551
II	991	564	1 288	515
III	615	406	927	457
IV+	840	568	769	743
Total No.	2 446 (±623)	3 215 (±728)	2 984 (±565)	3 266 (±640)
Total Wt (lbs)	1 665 (±521)	1 918 (±538)	1 756 (±370)	2 094 (±644)

1 No spring 1981 estimates for III+ rainbow trout due to spawning movements.

2 No spring estimate for yearling rainbow and brown trout.

Table 5. Comparison of brown and rainbow trout numbers and biomass in the Pine Butte section from September 1977[1] with 1978-1981[2] (all trout III+).

Year	SEPT Population Estimate	SEPT Total Biomass Estimate (lbs)	% Change From September 1977 Numbers	Biomass
1977	1 387	1 720	--	--
1978	2 158	2 531	+ 56	47
1979	4 072	4 073	+ 191	137
1980	4 083	3 633	+ 194	111
1981	4 694	4 057	+ 238	136

[1] Following a year with the 10 trout or 10 lbs, one trout limit.

[2] After a catch-and-release only regulation.

Table 6. Comparison of number of brown and rainbow trout over 13 inches in the Pine Butte section, pre-1977 and post 1978-81[1] (numbers shown in trout-per-mile).

Species	1977	1978[1]	1979[1]	1980[1]	1981[1]
Rainbow	156	333	479	464	515
Brown	188	300	427	299	361
Total:	344 (±133)	633 (± 223)	906 (±300)	763 (±197)	876 (± 257)

[1] Following a catch-and-release only fishing regulation.

During years in which angling was allowed in the Snoball section (1975-1976), the summer mortality rate for larger rainbow and brown trout (III+) was excessive--62 to 75% (see Table 7). After one year of fishing closure, the summer mortality decreased to 18% for rainbow trout and 28% for brown trout. Summer mortality rates (III+) for the next four years of fishing closure (1978-1981) averaged 27% for rainbow trout and 26% for brown trout. In 1977 the Pine Butte study section showed a high summer mortality (71% rainbow; 44% brown) under the 10 trout or 10 pound, one trout limit. With the advent of the catch-and-release angling regulation in the Pine Butte section in 1978, the summer mortality rates for larger rainbow trout (III+) decreased to 47%, while brown trout (III+) decreased to 34%. For the three catch-and-release seasons of 1978-1980, the average summer mortality for III+ rainbow and brown trout were 47% and 26%, respectively. The higher summer mortality rates for III+ rainbow trout in the catch-and-release section versus the "closed to fishing" section probably were associated with hooking, playing and releasing of the trout.

Mortality rates of wild trout can be divided into two main categories: (1) density independent mortality--mortality due to such factors as disease, accidents, old age and predation, which would occur regardless of population densities; and (2) density dependent mortality--mortality due to fish numbers greater than existing habitat can support (angler-caused mortality usually falls within this mortality). Density independent mortality occurs at a given rate in a population all year, whereas the rate of density dependent mortality increases during period when populations exceed existing carrying capacities. Increased trout growth during summer months tends to increase biomass beyond carrying capacities, only to be reduced during the cooler low flow winter periods. Most mortality rate figures are the sum of the independent and dependent mortality. In order to indentify the density independent mortality, trout populations must be well below carrying capacities and then the factor(s) "suppressing" the trout population must be eliminated. Those mortalities occurring before the trout achieve carrying capacity should be the density independent mortality. Since the number of III+ brown and rainbow trout were suppressed well below carrying capacity in the Snoball section because of high angler-induced fish mortality, all mortality which occurred during the first summer of the fishing closure probably was of the density independent type (18%). Similarly, the low winter mortality rates in 1975-76 and 1976-1977 were of the density independent type due to the excessively high losses caused by anglers the previous summer. Given existing growth and recruitment rates, the summer mortality rates for III+ brown and rainbow trout could reach 50% without reducing these fish below their carrying capacity. Summer mortality on the Pine Butte section for larger rainbow trout (III+) can be broken into two categories: (1) density independent--20-25%, and (2) density dependent--25-30%--that available to anglers, of which 20-25% is taken up by handling and release losses, leaving 5-10% for actual harvest.

Changing from a 10 trout or 10 pound-one trout creel limit in 1977 to a catch-and-release artificial lures only regulation in 1978 resulted in changes in the catch rate and angling pressure. After the first year of the special angling regulation (1978), fishing pressure decreased 41%; however, by the second year the pressure exceeded the 1977 levels by 4.0%. By the fourth year of catch-and-release fishing, the angling pressure had

Table 7. Comparison of summer mortality rates for III+ brown and rainbow trout in the Snoball and Pine Butte sections under various angling regulations.

Year[1]	Summer Mortality Rate (April - September) Rainbows	Browns	Type of Regulation
		SNOBALL	
1975	75 %	73 %	10 Trout Limit [2]
1976	75	62	10 Trout Limit [2]
1977	18	28	1st Year Closed to Fishing
1978-81[3]	27	26	Closed to Fishing
		PINE BUTTE	
1977	71 %	44 %	10 Trout Limit[2]
1978	47	34	Catch-and-Release Only
1979	50	11	Catch-and-Release Only
1980	45	33	Catch-and-Release Only
1981	--[4]	29	Catch-and-Release Only

1 Data for 1975-79 from Vincent, 1977, 1978, 1979 and 1980.

2 Trout limit also could be 10 lbs and one trout.

3 Average for four summers.

4 No spring rainbow available due to spawning movement.

increased 6.4% over the 1977 levels (see Table 8). An inverse relationship existed between catch rates and angling pressure for the 1977-1981 period. The highest catch rate occurred in 1978 under the lowest fishing pressure and the lowest catch rates occurred in 1981 with the highest fishing pressure. The total trout caught and handled was the highest in 1979--11,561 (101% of the spring numbers of II+), and lowest in 1981--6,820 (77% of the spring numbers of II+). During 1981, the months of July and August comprised 79% of the fishing pressure, which corresponds to the peak non-resident use (Table 9). Catch rates of rainbow trout were highest in May and lowest in September during 1981. Brown trout catch rates were consistent throughout the fishing period.

The reduction in trout harvest due to the catch-and-release angling regulation installed in 1978 has resulted in increased numbers of larger trout (13 inches and larger) in the Pine Butte study section, although total catch rates are somewhat dependent on the degree of angling pressure.

Gallatin River

Wild trout population estimates were made in two sections of the Gallatin River. These sections were set up to evaluate the effect of special creel limits on the wild trout population. One section, Jack Smith Bridge, was maintained as as control section where the trout limit was 5 trout, of which one could exceed 18 inches. The other section, Durnam Bridge, was placed under the special angling regulation where the creel limit was 3 trout under 13 inches and one to exceed 22 inches and artificial lures only. Comparison of wild rainbow trout populations shows a high summer mortality of IV+ trout in the control section where the 5 trout limit exists (see Table 10). The number of wild rainbow trout over 13 inches decreased 40% over the summer period (March to October) in the control (5 trout limit) section (Table 11).

Table 8. Comparison of angling pressure, catch rates, and total II+ trout caught in the Pine Butte section from 1976 through 1981 (80% confidence intervals for trout population estimate and 95% for angling pressure shown in parentheses).

Year[1]	Spring Trout Population (II+)	Angling Pressure (Hrs)	Catch Rates (Trout/Hour)	Total Trout Handled[2]
1976[3]	--	6 693 (±811)	--	--
1977	10 820 (±1665)	7 111 (±505)	1.37	9 061
1978	12 351 (±1501)	4 208 (±200)	2.75	11 561
1979	10 884 (±1328)	7 376 (±725)	1.49	10 984
1981[4]	8 866	7 567 (±621)	0.90	6 820

[1] Data for 1977-79, Vincent 1980.

[2] Total trout caught.

[3] Only angling pressure available.

[4] Rainbow trout estimate assumes 5% winter loss of III+.

Table 9. Comparison of monthly angling pressure, average catch rates, and total brown and rainbow trout caught and released for 1981 (95% confidence intervals shown in parentheses). Pine Butte section is 3.0 miles in length.

Month	Angling Pressure (Hrs)	Catch Rates (Fish/Hr) Rainbow	Brown	Total Fish Handled[1] Rainbow	Brown
May	670	0.98	0.37	660	249
June	1 062	0.76	0.23	805	249
July	3 046	0.60	0.21	1 840	635
August	1 902	0.67	0.28	1 269	527
September	887	0.45	0.21	400	187
Total	7 567 (±627)	0.66	0.24	4 974 (±602)	1 847 (±180)

[1] Total trout caught and released.

Table 10. Wild rainbow trout population, biomass, and age structure estimate for the Durnam Bridge and Jack Smith Bridge sections of the Gallatin River for 1981 (80% confidence intervals in parentheses).

Figures shown are per mile.

Age Group	Spring Population Estimate (March)	Fall Population Estimate (October)	Summer Mortality (March - September)
	DURNAM BRIDGE SECTION (Special Angling Regulations)[1]		
I	--[2]	1 538	--
II	--[3]	1 957	--
III	979	859	12 %
IV	405	350	13 %
V+	307	202	34 %
Total No.	1 691 (±279)	4 906 (± 577)	
Total Lbs.	728 (± 96)	1 352 (± 138)	
	JACK SMITH BRIDGE (5 Trout Limit)		
I	--[2]	1 435	--
II	--[3]	1 868	--
III	1 135	1 072	5 %
IV	630	362	43 %
V+	557	180	68 %
Total No.	2 322 (±522)	4 917 (±764)	
Total Lbs.	1 161 (±227)	1 511 (±200)	

[1] Trout limit: 3 under 13 inches and 1 over 22 inches.

[2] Insufficient size to make estimates.

[3] Insufficient recaptures to make estimates.

Table 11. Comparison of the number of rainbow trout by size between the Durnam Bridge section (special angling regulation) and the Jack Smith Bridge section (general 5 trout limit) on the Gallatin River (80% confidence intervals in parentheses).

Numbers shown per mile.

Size (In.)	Durnam Bridge Section (Special Angling Regulations)[1] Spring (March)	Fall (Oct)	Jack Smith Bridge Section (General 5 Trout Limit) Spring (March)	Fall (Oct)
10 - 12.9	595 (±102)	1 024 (±207)	932 (±234)	1 121 (±485)
13.0 +	145 (± 46)	156 (± 55)	284 (±123)	171 (± 52)

[1] 3 trout under 13 inches and 1 over 22 inches.

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