208 FISHERIES STUDY

Submitted

to

Blue Ribbons of the Big Sky Country
Areawide Planning Organization

December, 1977

Addendum

to

THE RELATIONSHIP BETWEEN FLOW REGIMES AND TROUT POPULATIONS IN THE WEST GALLATIN RIVER, MONTANA

By

Frederick A. Nelson
Fisheries Biologist
Montana Fish & Game Dept.
Bozeman, Montana

INTRODUCTION

The number and biomass of trout and mountain whitefish were estimated using electrofishing techniques in Section I (Williams Bridge) and II (Shedds Bridge) of the West Gallatin River in September, 1977. Estimates for individual age groups were not available for inclusion in this report. Flows were measured weekly at four sites between March and November, 1977.

RESULTS

Section I (Williams Bridge)

Flows during the summer of 1977 were reduced compared to flows in the summer of 1976 (Figure 1). The minimum summer flow measured in 1976 (523 cfs) was 1.3 times the minimum summer flow measured in 1977 (393 cfs). The lowest flow measured in 1977 (287 cfs) occurred in March. Flows in the March-early April period were lower than those measured in the summers of 1976 and 1977.

The population of age II and older rainbow trout decreased between September, 1976 and September, 1977 (Table 1). The number in September, 1977 was 91% of the number in April, 1977 and 74% of the number in September, 1976. Biomass in September, 1977 was 86% of the biomass in April, 1977 and 76% of the biomass in September, 1976.

The estimated number of age II and older brown trout increased slightly during the study (Table 1). The number in September, 1977 was 116% of the number in April, 1977 and 120% of the number in September, 1976.

The estimated biomass of age II and older brown trout decreased between September, 1976 and April, 1977 and increased between April and September, 1977 (Table 1). Biomass in September, 1977 was 172% of the biomass in April, 1977 and 109% of the biomass in September, 1976.

The population of age III and older whitefish decreased during the

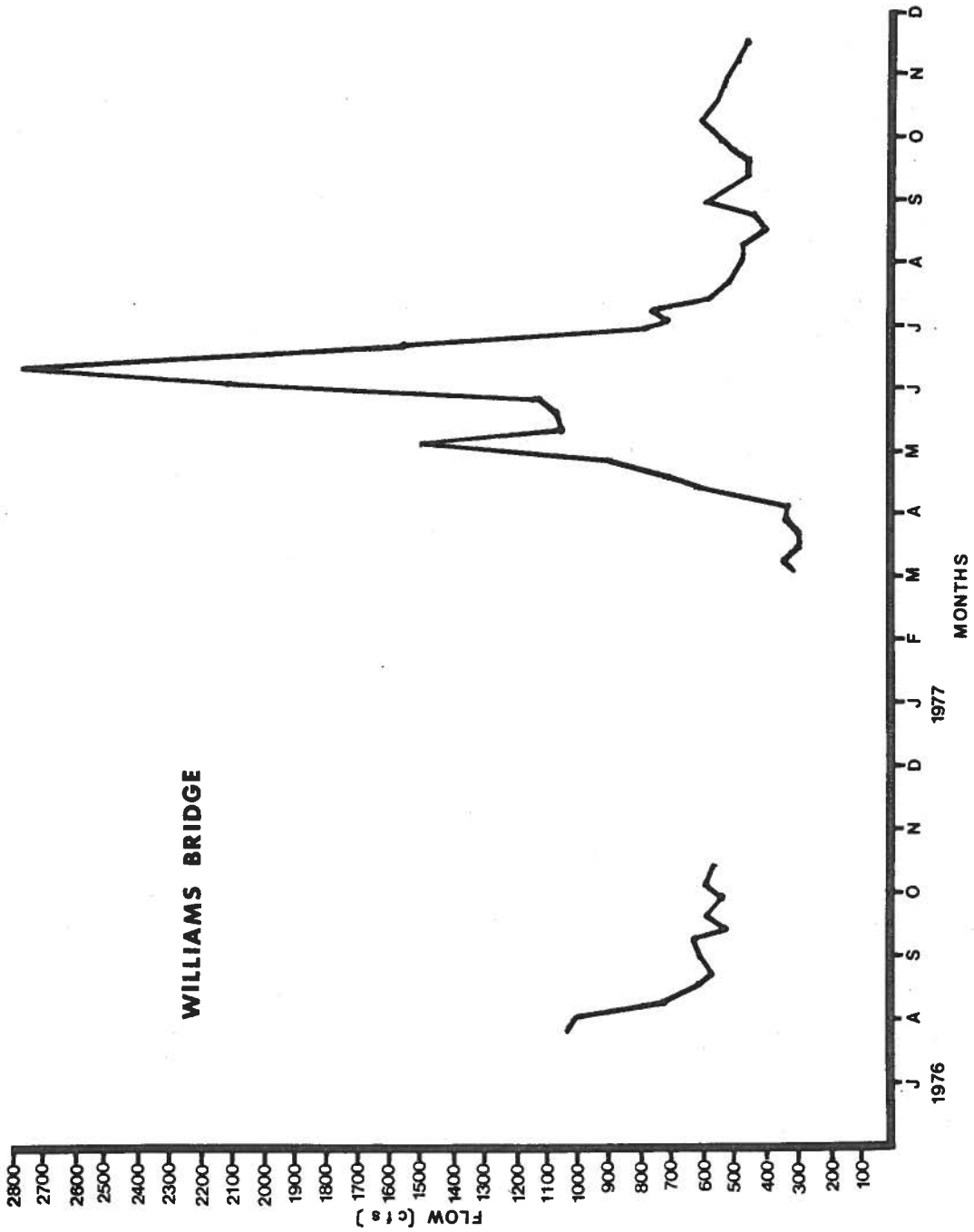

FIGURE 1. Weekly flows at the Williams Bridge gaging site on the West Gallatin River in 1976 and 1977.

study (Table 1). The number in September, 1977 was 73% of the number in April, 1977 and 68% of the number in September, 1976. The biomass in September, 1977 was 86% of the biomass in April, 1977 and 67% of the biomass in September, 1976.

At the 5% level of significance ($p \leq .05$), none of the estimates of numbers and biomass of age II and older rainbow and brown trout and age III and older mountain whitefish in September, 1976, April, 1977 and September, 1977 were statistically different.

Anglers returned 6.3% (37) of the 585 tags attached to brown and rainbow trout in Fall, 1976 and Spring, 1977. Of the tags attached to brown and rainbow trout between 9.0 and 14.0 inches in length, anglers returned 5.3 and 6.5%, respectively. Of the tags attached to brown and rainbow trout greater than 14.0 inches in length, anglers returned 3.9 and 14.8%, respectively. Sixteen percent (4) of the rainbow trout and 58% (7) of the brown trout were known to have been caught outside of Section I. Tagged brown and rainbow trout were caught as far as 8 and 5 miles, respectively, upstream of Section I. Seventy-three percent of the tagged trout were known to have been caught in the months of June, July, August, and September, 1977. July, 1977 was the most productive month, yielding 32% of the returns.

Section II (Shedds Bridge)

Flows during the summer of 1977 were reduced compared to those in the summer of 1976 (Figure 2). The minimum summer flow measured in 1976 (396 cfs) was 1.6 times the minimum summer flow measured in 1977 (250 cfs).

The populations of age II and older brown trout and age III and older mountain whitefish increased between April and September, 1977 (Table 2). The number and biomass of brown trout in September, 1977 were 111 and 129%

TABLE 1. Estimates of the number (number/1000 feet) and biomass (lbs/1000 feet) of trout and mountain whitefish in Section I (Williams Bridge) of the West Gallatin River in September, 1976, April, 1977 and September, 1977. 95% confidence interval in parentheses

Age	Sept., 1976	April, 1977	Sept., 1977
		Rainbow Trout	
	Number/1000 ft		
II & older	214 (130-298)	172 (119-225)	158 (112-204)
	Pounds/1000 ft		
II & older	105 (71-146)	93 (63-123)	80 (59-101)
		Brown Trout	
	Number/1000 ft		
II & older	98 (63-133)	102 (51-153)	118 (77-159)
	Pounds/1000 ft		
II & older	116 (74-157)	74 (43-106)	127 (67-187)
		Mountain Whitefish	
	Number/1000 ft		
III & older	496 (351-641)	467 (253-681)	339 (266-412)
	Pounds/1000 ft		
III & older	475 (332-618)	374 (215-533)	320 (254-386)

respectively, of those in April, 1977. The number and biomass of mountain whitefish were 162 and 193%, respectively, of those in April, 1977. Of these estimates, only the increase in biomass of mountain whitefish was significant at the 5% level ($p \leq .05$).

Anglers returned 12.4% (27) of the 217 tags attached to brown trout in Spring, 1977. Anglers also returned 9.7% (3) of 31 rainbow trout tags. Four (14.8%) of the tagged brown trout were known to have been caught outside of Section II. Tagged brown trout were caught as far as 6 miles

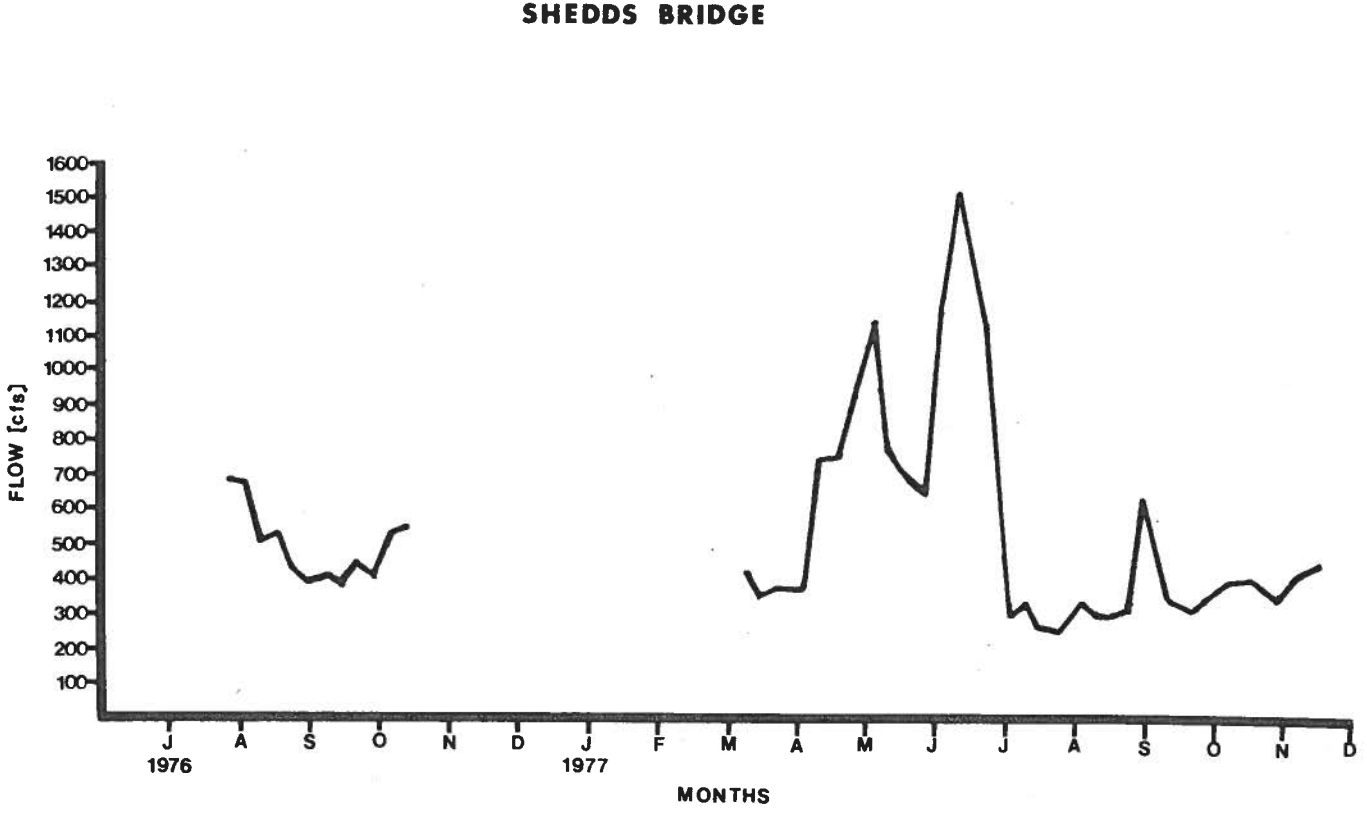

FIGURE 2. Weekly flows at the Shedds Bridge gaging site on the West Gallatin River in 1976 and 1977.

TABLE 2. Estimates of the number (number/1000 feet) and biomass (pounds/1000 feet) of brown trout and mountain whitefish in Section II (Shedds Bridge) of the West Gallatin River in April and September, 1977. 95% confidence interval in parentheses.

Age	April, 1977	September, 1977
	Brown Trout	
	Number/1000 ft	
II & older	197 (125-269)	218 (134-302)
	Pounds/1000 ft	
II & older	112 (75-150)	144 (98-190)
	Mountain Whitefish	
	Number/1000 ft	
III & older	433 (309-557)	703 (530-876)
	Pounds/1000 ft	
III & older	335 (242-428)	647 (488-806)

upstream of Section II. Eighty-three percent of the tagged trout were known to have been caught in the months of April, June, and August, 1977. June, 1977 was the most productive month, yielding 40% of the returns.

Section III (Irving Bridge)

An extensive fish kill was documented in Section III in July, 1977 when flow ceased for an approximate 5-day period. The lowest flow measured in Section III in the summer of 1976 was 198 cfs (Figure 3). Refuges did exist both upstream and downstream of Section III during dewatering. Springs provided flow downstream of the section. When Section III was totally dewatered, a flow of 30 cfs was measured at the Manhattan Bridge (Figure 4).

An electrofishing run was made on September 19, 1977. Nineteen brown trout, averaging 13.5 inches in length and 0.92 pounds in weight;

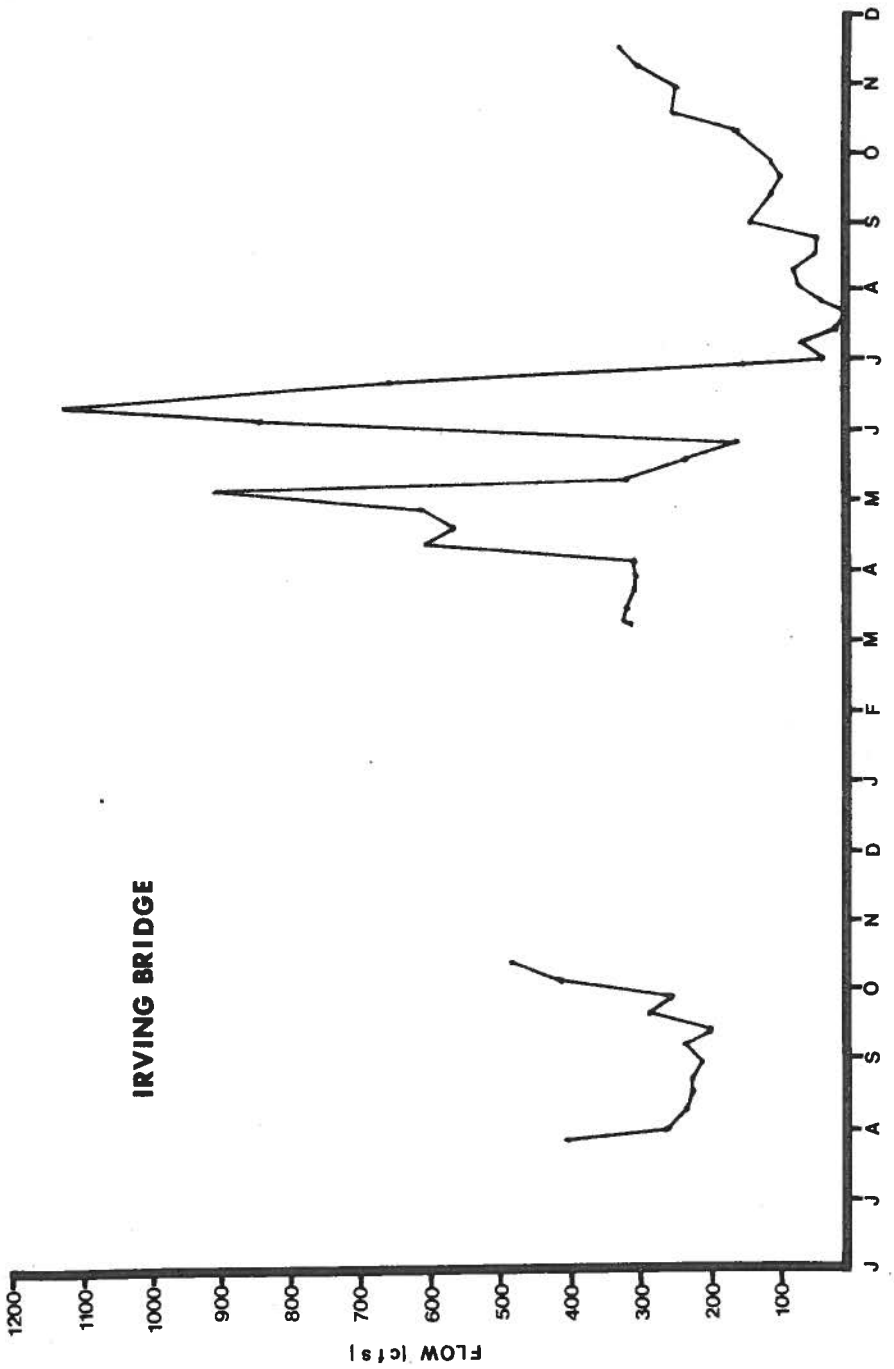

FIGURE 3. Weekly flows at the Irving Bridge gaging site on the West Gallatin River in 1976 and 1977.

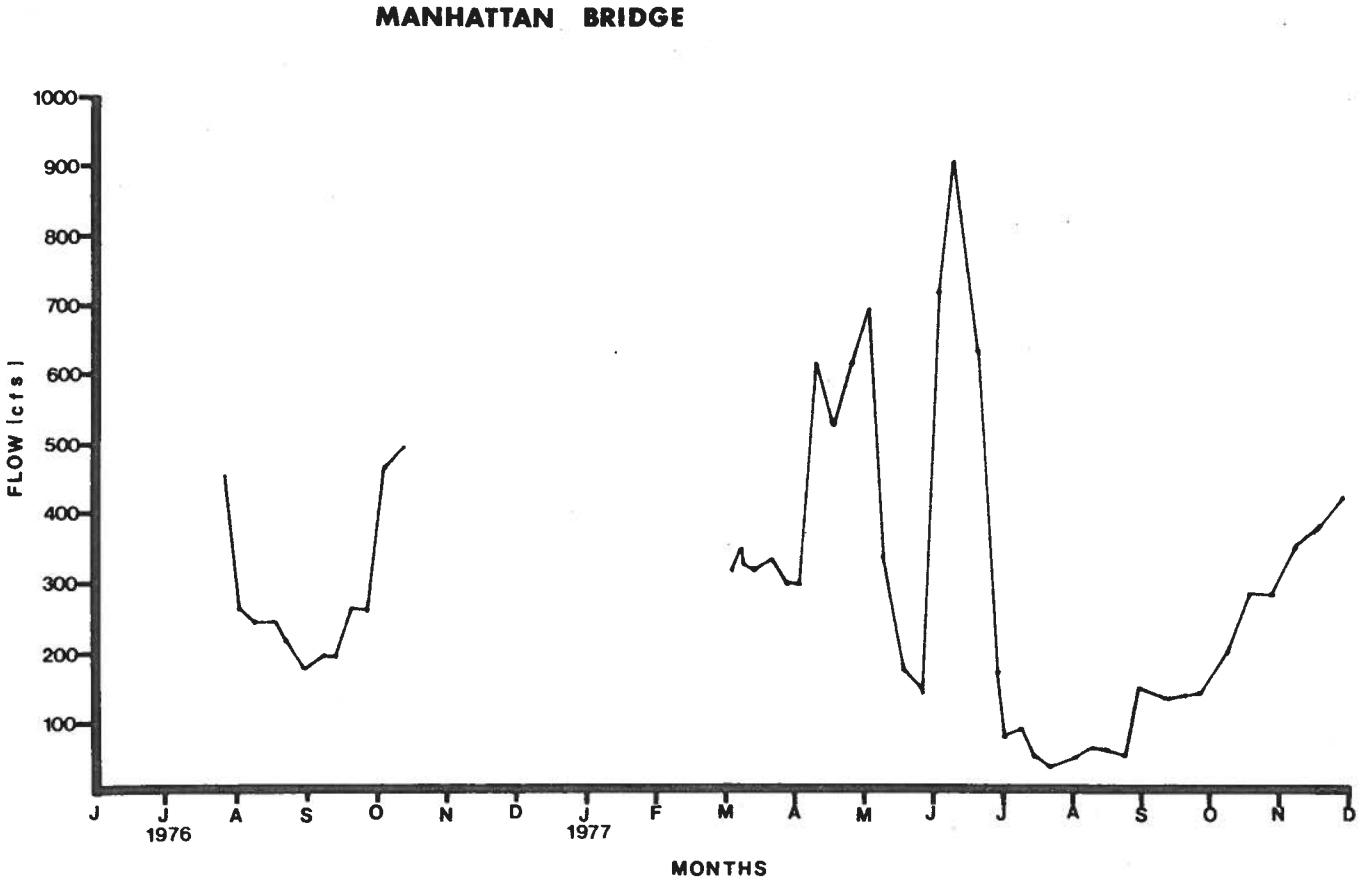

FIGURE 4. Weekly fows at the Manhattan Bridge gaging site on the West Gallatin River in 1976 and 1977.

65 whitefish, averaging 10.7 inches in length and 0.60 pounds in weight; and one brook trout were collected. Ninty-one percent of the 85 fish were captured in the upper 3900 ft of this 8000 ft section.

Anglers returned 2.7% (5) of the 186 tags attached to brown trout in Fall, 1976 and Spring, 1977. Two of the five tagged trout were caught outside Section III as far as 5 miles upstream. Another five tags were removed from dead and dying trout during the July dewatering.

DISCUSSION

Section I (Williams Bridge)

Results of the study suggest the flows in 1977 were not sufficiently reduced to adversely affect brown trout. The estimates of number and biomass of age II and older brown trout in September, 1976, which followed two above average water years, were not greater than those in September, 1977. The slight increase in the number of age II and older brown trout between April and September, 1977 may reflect a prespawning movement of brown trout into this section. Angler tag returns suggest that considerable movement does occur.

The estimated number and biomass of age II and older rainbow trout decreased between September, 1976 and September, 1977, although this decrease was not statistically significant ($p \leq .05$). The rate of population decrease of age II and older rainbow trout was 39% between September, 1976 and April, 1977 while only 8% between April and September, 1977. The greatest rate of decrease (39%) occurred during the winter when angler caused mortality is insignificant. The 39% rate of decrease also followed the lowest flows measured in 1977. Whether or not a winter decrease of 39% is excessive for the West Gallatin River is unknown. Compared to brown trout, the rate was elevated (39% versus 16%). Compared to other

rivers in Montana, it is not considered excessive.

Between April and September, 1977, biomass estimates of age II and older rainbow trout decreased by 14%. Considering the low reduction in numbers (8%) that occurred during this period, a reduction in biomass would not be expected following the summer growing season, unless the reduction in numbers represents a loss of only the larger and older rainbow trout. Flow reductions can affect older rainbow trout more severely than other age groups of trout. Nelson (manuscript in preparation) showed the survival of age III and older rainbow trout in the upper Beaverhead River, Montana was directly related to the magnitude of flows, while brown trout and younger rainbow trout were less affected by flow reductions. Angling may also be a factor. Voluntary tag returns indicate anglers were selectively harvesting the larger rainbow trout in the summer of 1977. Both flow reductions and angling may be responsible for the decrease in the number and biomass of rainbow trout that occurred during this study. A creel census must be incorporated into any future investigations of trout-flow relationships in Section I of the West Gallatin River to determine the exact role of angling in regulating the rainbow trout population.

The estimated number and biomass of age III and older mountain whitefish decreased between September, 1976 and September, 1977. These decreases were not statistically significant at the 5% level ($p \leq .05$), but were significant at the 20% level ($p \leq .20$). The decline of the whitefish population may reflect flow reductions, since it is unlikely angling is a contributing factor.

Section II (Shedds Bridge)

The estimated number of age II and older brown trout in April, 1977

was not greater than the number in September, 1977. It appears flows were not sufficiently reduced in the summer of 1977 to adversely affect brown trout.

The slight increase in the estimated number of brown trout that occurred between April and September may partially reflect the upstream movement of trout from the severely dewatered downstream sections. Two trout tagged in Spring, 1977 in Section III, which was completely dewatered for a 5-day period in July of 1977, were recaptured by electrofishing approximately 5 miles upstream in Section II in Fall, 1977. The dramatic increase in the estimated number and biomass of age III and older whitefish may also reflect this upstream movement. Clothier (1952) showed that trout in irrigation diversions of the West Gallatin River moved upstream when flows in the diversions were reduced.

Section III (Irving Bridge)

Based on the April, 1977 estimates, the complete dewatering of this study section resulted in a loss of approximately 126 age II and older brown trout/1000 ft and 289 age III and older mountain whitefish/1000 ft (Table 3). Some of these fish may have moved out of the section prior to total dewatering.

The electrofishing survey two months after dewatering indicated that repopulation had already begun and the fish were coming from an upstream source. Some of these fish may have been returnees that moved upstream prior to total dewatering. A brown trout tagged in September, 1976 was recaptured by electrofishing in Section III in September, 1977.

TABLE 3. Estimates of the number (number/1000 feet) and biomass (pounds/1000 feet) of brown trout and mountain whitefish in Section III (Irving Bridge) of the West Gallatin River in September, 1976 and April, 1977. 95% confidence interval in parentheses.

Age	September, 1976	April, 1977
	Brown Trout	
	Number/1000 ft	
II & older	103 (63-143)	126 (101-151)
	Pounds/1000 ft	
II & older	95 (43-157)	70 (41-99)
	Mountain Whitefish	
	Number/1000 ft	
III & older	169 (110-227)	289 (157-419)
	Pounds/1000 ft	
III & older	155 (98-212)	255 (139-371)

Water Temperatures

Flow reductions in 1977 resulted in higher summer water temperatures throughout the West Gallatin River (Figure 5). The highest water temperature recorded in 1977 (78F) occurred in Section III (Irving Bridge) prior to total dewatering. Higher water temperatures in 1977 may have improved trout growth in Sections I (Williams Bridge) and II (Shedds Bridge). However, higher temperatures in the lower river probably had a detrimental affect on growth.

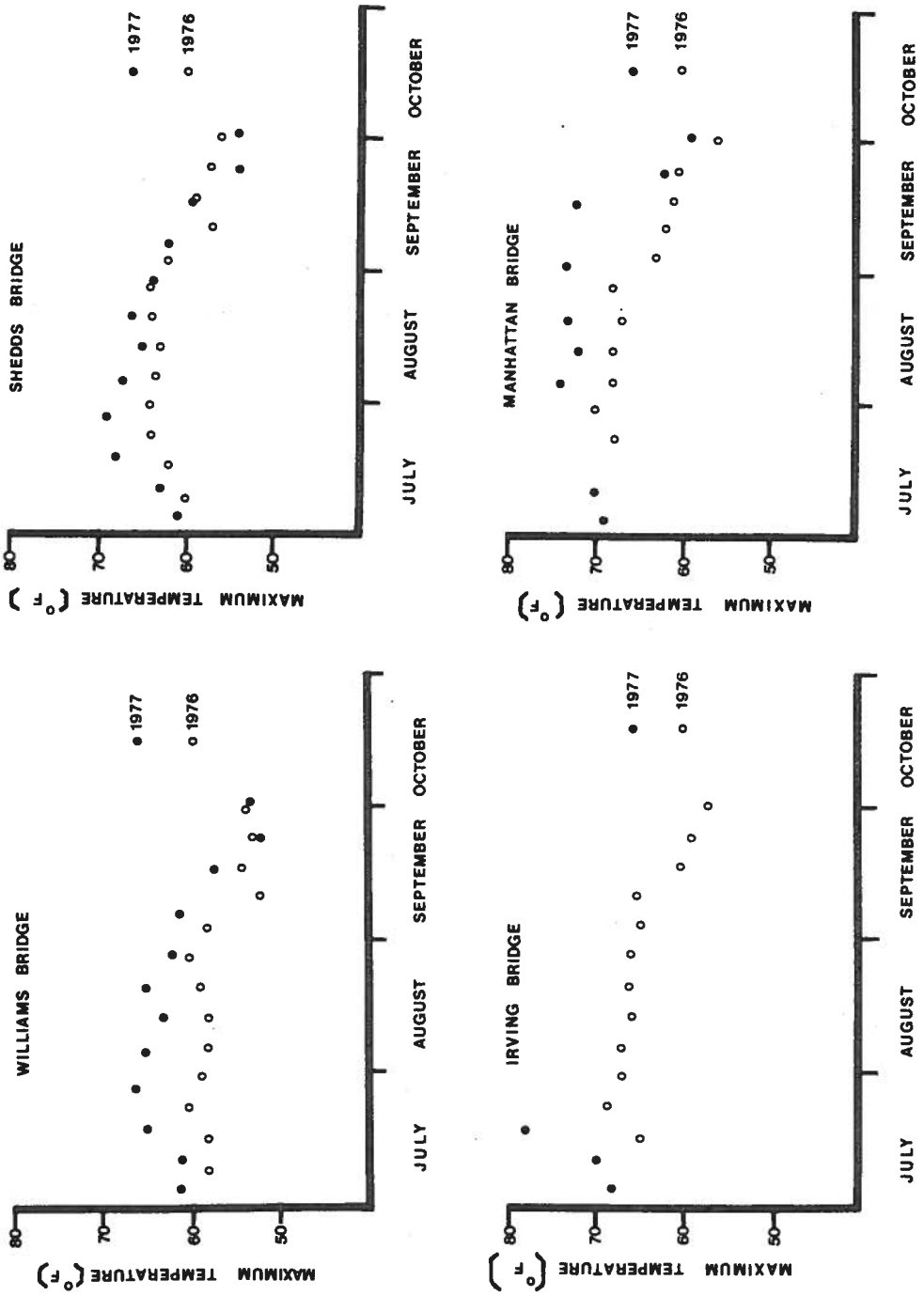

FIGURE 5. Maximum weekly water temperatures in the West Gallatin River in 1976 and 1977.

CONCLUSIONS

1. Flow reductions in 1977 were not sufficient to adversely affect the brown trout population in Section I (Williams Bridge). Populations of rainbow trout and mountain whitefish in Section I decreased during the study, although these decreases were not statistically significant ($p \leq .05$). The decreases may reflect the reduced flows in 1977. However, angling may also be contributing to the decline of rainbow trout.

2. Flow reductions in 1977 were not sufficient to adversely affect populations of brown trout and mountain whitefish in Section II (Shedds Bridge). However, the impact of flow reductions on fish populations in Section II may have been masked by the upstream movement of brown trout and mountain whitefish from the severely dewatered downstream sections.

3. Based on April, 1977 estimates, the total dewatering of Section III (Irving Bridge) in July, 1977 resulted in a loss of approximately 126 age II and older brown trout/1000 ft and 289 age III and older mountain whitefish/1000 ft. Repopulation of Section III had already begun two months after dewatering. These fish came from an upstream source.

RECOMMENDATIONS

1. A water management program by the West Gallatin water users, which would provide for the appointment of a water commissioner prior to extensive dewatering, could avert future fish kills on the West Gallatin River.

2. A creel census should be incorporated into any future investigation of fish-flow relationships in the West Gallatin River to measure the impact of angling on trout populations, particularly rainbow trout.

LITERATURE CITED

Clothier, W.D. 1952. Fish loss and movement in irrigation diversions from the West Gallatin River, Montana. M.S. Thesis, Montana State University, 32pp.