MONTANA DEPARTMENT OF FISH, WILDLIFE AND PARKS

FISHERIES DIVISION

JOB PROGRESS REPORT

STATE: Montana TITLE: Southwestern Montana Fisheries Study

PROJECT NO.: F-9-R-28 TITLE: Investigation of the Influence of Clark Canyon Reservoir on the Stream Fishery of the Beaverhead River

JOB NO.: II-a

PROJECT PERIOD: July 1, 1979 through June 30, 1980

REPORT PERIOD: July 1, 1979 through June 30, 1980

ABSTRACT

Brown and rainbow trout numbers and biomass were determined in the Hildreth Section of the Beaverhead River. Flow was measured at the U.S. Geological Survey gage near Grant, Montana.

Fall numbers of age I and older rainbow trout in 1979 were reduced from 1978. This reduction was due to a poor year class of age I fish and decreased numbers of age III and older fish. Estimated biomass for age I and older rainbow trout in 1979 was nearly as great as in 1978 due to a strong year class of age II fish.

Brown trout numbers and biomass in the spring of 1980 were greater than in 1979 due to a good year class of age II fish and increased numbers of age II and older fish. Increased densities of brown trout since 1975 has resulted in decreased growth rates for all age groups and may play a part in outbreaks of furunculosis.

BACKGROUND

The effect of flow releases from the Clark Canyon Dam on trout populations in the Beaverhead River has been investigated since 1966 by the Montana Department of Fish, Wildlife and Parks. The presence of large numbers of trophy size trout in the upper reaches of the river has characterized the fishery during the study period. The results of this study have been reported by Nelson (1978) and indicate that low (less than 250 cfs) non-irrigation season flows have an adverse effect on survival of larger and older rainbow trout in the upper reaches of the Beaverhead River. The study also showed extreme flow fluctuations during the spawning seasons adversely effected recruitment into the trout population.

Since 1973-74 there has been a tremendous increase in the numbers of trout in the Hildreth Section of the Beaverhead River. These increases have been directly attributable to more favorable spawning flow releases from Clark Canyon Dam. These increases in numbers of brown and rainbow trout have resulted in decreased growth rates for both species (Wells, 1979). Numbers of trophy size brown and rainbow trout (five pounds and larger) have also decreased markedly, coincident with increased densities of both species since 1973-74.

OBJECTIVES AND DEGREE OF ATTAINMENT

To determine spring and fall trout populations in the Hildreth Section of the Beaverhead River. Data is presented.

To determine the effort of increasing densities of trout on growth rates. Data is presented.

To evaluate the effect of flow releases on trout populations. Data is presented.

PROCEDURES

Trout population estimates were made using the Peterson mark-and-recapture technique with boat mounted electrofishing equipment. Computations were made using an existing computer program.

Flow was measured at the U.S. Geological Survey gage station near Grant, Montana.

FINDINGS

Rainbow Trout

Fall, 1979 estimates for age I and older rainbow trout are compared with estimates from 1972-78 in Table 1.

Table 1. Estimated fall numbers of rainbow trout by age groups in the Hildreth Section (6,445 feet) of the Beaverhead River between 1972 and 1979[1/]. 80% confidence intervals in parentheses.

	AGE GROUP				
	I	II	III	IV & Older	Total
1972	140	zero	14	60	214 ($\pm$69)
1973	136	114	28	53	331 ($\pm$75)
1974	997	143	55	15	1210 ($\pm$253)
1975	796	281	26	4	1107 ($\pm$321)
1977	274	241	159	26	701 ($\pm$131)
1978	895	224	156	63	1338 ($\pm$230)
1979	290	462	74	39	865 ($\pm$144)

[1/] Population estimate not made in Fall, 1976.

Numbers of age I and older rainbow trout in the fall of 1979 were considerably reduced from the fall of 1978 and reflect a weak age 1 year class recruited into the population. The causes of this weak year class of age 1 fish, which was similar to the year class in 1977 (Wells, 1978), are not clear. Flows during the spawning season that produced this year class (March 1-31, 1978) were stable (U.S.G.S., 1979) and similar to the flows that resulted in strong age I year classes in 1974, 1975 and 1978 (U.S.G.S., 1975, 1976, 1979).

Numbers of age II rainbow trout in the fall of 1979 are the greatest of the study period and reflect the strong year class produced during the 1977 spawning season. This strong year class resulted in the greatest number of age II and older rainbow of the study period in 1979.

Numbers of age III and older rainbow trout in 1979 were the lowest since 1975.

Table 2 represents average daily flow (ADF), number of days greater and less than 250 cfs and annual rate of fall to fall population change (%) of age III and older to age IV and older rainbow trout in the Hildreth Section of the Beaverhead River between 1969 and 1979. Annual fall to fall mortality of these older and larger rainbow has fluctuated between 28 and 94 percent through the years of study. The magnitude of mortality appears to be related to non-irrigation season flow and Nelson (1978) suggested flows of less than 250 cfs had adverse effects on the survival of age IV and older rainbow. Average daily flows during the 1978-79 non-irrigation season were greater than 1977-78, but remained less than 250 cfs for all but nine days of this six month period. The 82 percent mortality experienced by these older rainbow between 1978 and 1979 continues to be excessive.

During the years of study, the lowest annual mortality of these older rainbow trout occurred when ADF was in excess of 300 cfs. It appears that in order to manage this fishery for these large trophy size rainbow, flows during the non-irrigation season must be in excess of 300 cfs.

Table 2. Non-irrigation season average daily flow (ADF), number of days greater and less than 250 cfs, and annual rate of fall to fall population change (%) of age III and older to age IV and older rainbow trout in the Hildreth Section of the Beaverhead River between 1969 and 1979.

Years	ADF	$\leq$250 cfs	>250 cfs	III & older > IV & older
1968-69	377	8	175	-49
1969-70	292	39	143	-78
1970-71	394			-36
1971-72	467	7	175	-42
1972-73	316	79	103	-28

Table 2. Cont.

Years	ADF	≤250 cfs	>250 cfs	III & older → IV & older
1973-74	200	152	30	-81
1974-75	97	182	0	-94
1977-78	163	182	0	-66
1978-79	232	173	9	-82

Fall, 1979 biomass estimates for age I and older rainbow trout are compared with estimates from 1972-1978 in Table 3. Fall, 1979 biomass estimates are only slightly less than 1978 estimates despite a marked decrease in numbers. This reflects the strong year class of age II rainbow trout in the fall of 1979, and masks the decrease in biomass for the other age groups.

Table 3. Estimated fall biomass (lbs/6455 ft.) of rainbow trout by age groups in the Hildreth Section of the Beaverhead River between 1972 and 1979[1/]. 80% confidence intervals in parentheses.

	AGE GROUP				
	I	II	III	IV & Older	Total
1972	146	0	33	301	480 (±177)
1973	164	306	113	320	903 (±251)
1974	1189	321	170	77	1857 (±379)
1975	721	676	84	23	1504 (±352)
1977	243	583	532	119	1477 (±251)
1978	651	415	412	248	1726 (±230)
1979	190	930	417	163	1500 (±278)

[1/] Estimate not made in fall, 1976.

Comparing mean weights of age groups over a period of years is one means of assessing growth in fishes. The mean fall weights by age groups for rainbow trout captured by electrofishing are presented in Table 4.

Table 4. Mean fall weights (pounds) by age groups for rainbow trout captured by electrofishing in the Hildreth Section of the Beaverhead River from 1972-1979.

	RAINBOW TROUT AGE GROUPS			
Fall	I	II	III	IV & Older
1972	1.05	-	2.37	5.02
1973	1.19	2.76	3.86	6.29
1974	1.19	2.24	4.94	5.23
1975	0.91	2.40	3.26	5.64
1977	0.89	2.42	3.35	4.56
1978	0.73	1.86	2.65	3.94
1979	0.65	2.01	2.93	4.19

Mean weights of all age groups in the fall of 1979 are slightly greater or nearly equal to the fall of 1978 when the population was the greatest of the study period. Density-growth relationships could not be shown by simple linear regression for any specific age groups of rainbow trout. However, mean weights of all age groups were much less in 1979 than during the 1973-74 period when numbers of age II and older rainbow trout were the lowest of the study period.

Brown Trout

Spring, 1980 estimates for age II and older brown trout are compared with estimates from 1974-79 in Table 5. Numbers of age II and older brown trout in the spring of 1979 were among the greatest of the study period. This was primarily due to one of the strongest age II year classes of brown trout of the years of study (1966-1980). The strong 1980 age II year class contrasts with the weak age II year class in 1979 and is attributable to the stable spawning and incubation flows of 1977-78 (U.S.G.S., 1977-78). Flows during the peak of spawning in 1977 (Oct. 15 - Nov. 15) were low (90-100 cfs) but stable and increased slowly to 150 cfs through the incubation and hatching period (November - March). This flow regime contrasts with the severe downward fluctuating flows from spawning through hatching (October - March) of 1976-77 that produced the weak year class of age II brown trout in 1979 (Wells, 1979).

Table 5. Estimated spring numbers of brown trout by age groups in the Hildreth Section (6,455 ft.) of the Beaverhead River between 1974 and 1980. 80% confidence intervals in parentheses.

	AGE GROUP				
	I	II	III	IV & Older	Total
1974	-	32	90	195	317 (±50)
1975	-	467	61	142	670 (±82)
1976	-	624	420	139	1183 (±285)
1977	-	864	410	475	1752 (±259)
1978	-	565	791	338	1694 (±352)
1979	-	329	536	442	1307 (±291)
1980	-	733	370	504	1607 (±261)

Numbers of age IV and older brown trout in the spring of 1980 were the greatest of the study period. Numbers of age III brown trout in spring, 1980 were among the lowest of the study period and reflect the poor year class produced in the 1976 spawning season.

Table 6. Estimated spring biomass of brown trout by age groups in the Hildreth Section (6,566 ft.) of the Beaverhead River between 1974 and 1980. 80% confidence intervals in parentheses.

	AGE GROUP				
	I	II	III	IV & Older	Total
1974	-	34	167	645	846 (±129)
1975	-	406	121	503	1030 (±146)
1976	-	503	666	512	1681 (±371)
1977	-	669	667	1288	2624 (±555)
1978	-	488	1170	878	2536 (±543)
1979	-	296	860	1057	2213 (±536)
1980	-	577	610	1344	2531 (±399)

Spring, 1980 biomass estimates for age II and older brown trout are compared with estimates from 1974-79 in Table 6. Fall, 1980 biomass estimates for age II and older trout are among the highest of the study period. The biomass estimate for age IV and older brown trout in the spring of 1980 was the greatest of the study period.

Biomass estimates for age II and older brown trout increased dramatically from 1974 to 1977 but have remained at nearly 2500 pounds from 1977 to 1980. Table 7 depicts mean spring weights of brown trout by age groups from 1974 to 1980.

Table 7. Mean spring weights (pounds) by age groups for brown trout captured by electrofishing in the Hildreth Section of the Beaverhead River from 1974-1980.

	BROWN TROUT AGE GROUPS		
Spring	II	III	IV & Older
1974	1.06	1.87	3.30
1975	0.87	1.98	3.55
1976	0.81	1.59	3.68
1977	0.77	1.63	2.71
1978	0.86	1.48	2.60
1979	0.90	1.61	2.39
1980	0.79	1.65	2.67

Mean weights of age II, age III and age IV and older brown trout continue to be strongly density related. Simple linear regression showed mean weights

to be significantly correlated with numbers for each age group ($p=0.005$). Estimated numbers of ages II, III and IV and older brown trout explain 95%, 89% and 82% of the annual variation in mean weights of each age group respectively.

DISCUSSION

Numbers of age I and older rainbow trout decreased markedly from 1978 to 1979. This decrease was due mostly to a poor year class of age I fish but also reflects lower numbers of age III and older rainbow. Non-irrigation season flows in 1978-79 were less than the 250 cfs considered minimal for the survival of large rainbow trout (Nelson, 1978). Density-growth relationships could not be demonstrated by simple linear regression for specific age groups. However, mean weights of all age groups are considerably less than the 1972-73 period when numbers of rainbow were much less than in 1979.

Brown trout numbers have increased dramatically since 1975 and growth rates have declined. Brown trout numbers may well be at the carrying capacity of the river as evidenced by fish kills that have occurred during early July in 1978, 1979, and 1980. These kills have corresponded with reductions in flow (Figure 1) and have primarily affected adult brown trout. In July, 1980 the cause of the kill was identified as the bacterial disease, furunculosis (Aeromonus salmonicida). Outbreaks of furunculosis are typically brought on by stress. Brown trout may well be under a certain amount of stress due to their high numbers and the additional stress caused by decreased flow and associated increased water temperatures is evidently sufficient to cause outbreaks of furunculosis. This appears to be particularly true below the mouth of Hildreth's spring which enters the river at 70°F.

The fishery of the upper Beaverhead River has been regarded in the past as a trophy fishery because of the opportunity of catching trout over five pounds. Table 8 compares numbers of trophy trout ($\geq$ 5.0 lbs.) captured by electrofishing during the course of the study. Numbers of these large brown trout captured in 1980 were greater than in 1979, but remain much less than the 1974-75 period. Numbers of these large rainbow trout captured in 1979 are considerably less than for the 1973-74 period.

Table 8. Numbers of brown and rainbow trout $\geq$ 5.0 lbs. captured by electrofishing in the Hildreth Section (6455 ft.) of the Beaverhead River between 1966 and 1980.

	Brown Trout $\geq$ 5.0 lbs.		
Spring	Number Captured	No. Electrofishing Runs	No. Captured/Run
1967	0	2	0
1968	0	3	0
1969	0	4	0
1970	0	3	0

Table 8. Cont.

Spring	Brown Trout ≥ 5.0 lbs. Number Captured	No. Electrofishing Runs	No. Captured/Run
1971	0	4	0
1972	3	4	0.8
1973	-	-	-
1974	10	4	2.5
1975	13	5	2.6
1976	4	4	1.0
1977	5	4	1.3
1978	5	4	1.3
1979	2	4	0.5
1980	6	4	1.5

Fall	Rainbow Trout ≥ 5.0 lbs. Number Captured	No. Electrofishing Runs	No. Captured/Run
1966	3	2	1.5
1967	2	2	1.0
1968	11	3	3.7
1969	5	3	1.7
1970	8	4	2.0
1971	11	4	2.8
1972	9	4	2.3
1973	16	3	5.3
1974	13	3	4.3
1975	1	4	0.3
1977	7	4	1.8
1978	6	4	1.5
1979	5	4	1.3

The quality of the trophy fishery has diminished markedly since 1974-75 for both brown and rainbow trout. Decreases in numbers of these large brown trout appear to be due to both decreased growth rates and the bacterial disease furunculosis, both of which are related to increased densities of brown trout. Decreases in numbers of these large rainbow trout appear to be due to non-irrigation flows which have generally been less than the 250 cfs considered minimal for their survival by Nelson (1978).

RECOMMENDATIONS

This project should be continued. The effects of flow regime on recruitment and survival of trout should continue to be evaluated. The effect

of densities of trout on growth rates should continue to be evaluated. Efforts should be made to preserve the trophy nature of this fishery.

LITERATURE CITED

Nelson, F. A., 1978. Beaverhead River and Clark Canyon Reservoir Fishery Study. Montana Fish and Game Department, Bozeman, Mt. for U. S. Dept. Interior, Bureau of Reclamation, Contract No. 14-06-600-8790.

U. S. Department of Interior, Geological Survey, 1975-1979, Water Resources Data for Montana, Surface Water Records.

Wells, J. D., 1979. Inventory of the waters of the project area. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts. Montana Progress No. F-9-R-27, Job 1-d, 10 pp.

Wells, J. D., 1978. Inventory of the waters of the project area. Job Progress Report, Federal Aid in Fish and Wildlife Restoration Acts. Montana Progress No. F-9-R-26, Job 1-d, 8 pp.

Prepared by: Jerry D. Wells

Date: January 15, 1981

Waters Referred to: Beaverhead River, 3-01-0500-01

Key Words: Disease
Trout - Population Dynamics
Flow Regimes

Figure 1. Average daily flow at the U. S. Geologic Survey gage station near Grant on the Beaverhead River from June 16 through July 21, 1978-80.