

**FLAMING GORGE RESERVOIR
AND
GREEN RIVER
POST-IMPOUNDMENT INVESTIGATIONS
ANNUAL PERFORMANCE REPORT
1975**



PUBLICATION NUMBER 76-20
Dingell-Johnson Project Number F-28-R-4

639.3758
UTA
COPY 1

STATE OF UTAH
DEPARTMENT OF NATURAL RESOURCES
DIVISION OF WILDLIFE RESOURCES
John E. Phelps, *Director*

PROPERTY OF UTAH WILDLIFE
RESOURCES LIBRARY

FLAMING GORGE RESERVOIR AND GREEN RIVER

POST-IMPOUNDMENT INVESTIGATIONS

PROPERTY OF UTAH WILDLIFE
RESOURCES LIBRARY

Annual Performance Report
March 1975-December 1975

Victor Starostka
Project Leader

George Wilson
Project Biologist

Robert Wiley and David Dufek
Contributors

Publication Number 76-20
Dingell-Johnson Project Number F-28-R-4

Copyright © Utah State Division of Wildlife Resources 1976

An Equal Opportunity Employer

Donald A. Smith
Director

TABLE OF CONTENTS

	Page
LIST OF TABLES.	iii
LIST OF FIGURES	iv
JOB NUMBER	
F-I. MEASUREMENT OF RESERVOIR FISHERY HARVEST, PRESSURE, AND SUCCESS.	1
F-II. IMPACT OF MULTI-LEVEL OUTLETS ON FLAMING GORGE RESERVOIR AND DOWNSTREAM WATERS.	6
F-III. RESERVOIR FISH MARKING AND STOCKING.	9
F-IV. FLAMING GORGE TAILWATER CREEL CENSUS	22
F-V. TAILWATER FISH STOCKING AND MARKING.	37
F-VI. INTERSPECIFIC RELATIONSHIPS OF THE WHITE SUCKER IN FLAMING GORGE RESERVOIR.	40
LITERATURE CITED.	43

LIST OF TABLES

Table	Page
1. 1975 Flaming Gorge creel census summary with 1974 figures in parentheses. Percentages indicate change from 1974.	3
2. Summary of trout harvest information, Flaming Gorge Reservoir, 1963-1975	4
3. Numbers of trout checked during 1975 Flaming Gorge creel census with percentage of composition in parentheses.	6
4. Fish stocking summary by species and agency for Flaming Gorge Reservoir, 1975.	11
5. Comparison of returns from the 1972 plant of three inch rainbow trout and the 1973 plant of five inch rainbow trout, Flaming Gorge Reservoir	12
6. Percent age composition of the rainbow harvest from Flaming Gorge Reservoir, 1970 through 1975 by age groups	13
7. Catch per gill-net hour of fish captured in the canyon area, Flaming Gorge Reservoir	15
8. Catch per gill-net hour of fish captured in the open area, Flaming Gorge Reservoir	16
9. Catch per gill-net hour of fish captured in the inflow area, Flaming Gorge Reservoir	17
10. Mean total length (TL) of fish captured in gill nets, Flaming Gorge Reservoir 1963-1975.	19
11. Mean percent occurrence of food items in stomachs of lake trout collected from Flaming Gorge Reservoir, Utah, 1974-1975. Number of stomachs examined in parentheses.	20
12. Mean back-calculated TL of Flaming Gorge Reservoir rainbow trout, 1970-1975	21
13. Creel census summary, Green River tailwaters, 1975 .	23
14. Comparison of creel and catch rates of Snake River cutthroat and rainbow trout, Green River tailwaters, 1975 (catch rates in parentheses).	24

Table	Page
15. A comparison of angling pressure (angling hours per mile) on the Green River tailwaters, Utah with other areas	25
16. Species composition of the harvest, Green River tailwaters, 1975 (percent in parentheses.	26
17. Condition factors (TL) (numbers of fish in parentheses) of fish collected from the Green River tailwaters, May 31-August 16, 1975.	28
18. Comparison of the average total length of age class I+ rainbow trout creeled from different river selections, Green River tailwaters, 1974-1975	29
19. Average monthly recorded river temperatures, Green River tailwaters, 1974.	30
20. Monthly average length (mm) of creeled rainbow and Snake River cutthroat trout, Green River tailwaters, 1975 (sample size in parentheses)	32
21. Percent length-frequency distribution of rainbow trout, Green River tailwaters, 1967-1975	33
22. Comparison of angler use and effort estimates, Green River tailwaters, 1967-1975	34
23. Mean daily discharge flows (acre feet/day), Green River tailwaters, 1963-1975	36
24. Estimated number of marked rainbow trout fingerlings per 1,000 feet of side channel, Brown's Park, Green River tailwaters, 1975-1976	38
25. Mean length, weight and condition of white suckers taken from gill nets, 1969-1975, Flaming Gorge Reservoir	41

LIST OF FIGURES

Figure	Page
1. Flaming Gorge Reservoir.	2
2. Selected temperature and dissolved oxygen profiles from Log Boom and Bear Canyon, Flaming Gorge Reservoir, 1975.	9

MEASUREMENT OF RESERVOIR FISHERY HARVEST,
PRESSURE, AND SUCCESS

Job F-1

Flaming Gorge National Recreation Area experienced a resurgence of visitor use after a decline in 1974. Visitor day use (VDU) was 721,300 during 1975 compared with 652,800 VDU in 1974 or a 10.5 percent increased VDU.

Angling continued to comprise a substantial portion of VDU. During 1975, 20.2 percent of the total VDU was directed toward fishing. Mean fisherman length of stay in the National Recreation Area was 2.3 days and the mean angling day was 4.1 hours.

Reservoir creel census consisted of road blocks and traffic counters on major access roads to determine traffic classification and expansion factors. Area pressure, angler days, angler hours and harvest were determined from data collected during angler interviews.

Reservoir elevation was similar to 1974. The reservoir filled to capacity (1841 m, 6040 ft) creating approximately 42,000 surface acres (Fig. 1).

Harvest decreased by 6.1 percent during 1975 to 752,981 fish while angler hours increased 4.9 percent to 1,749,625 hours (Table 1). The net result was a decrease in catch rate from 0.49/hr in 1974 to 0.43/hr in 1975.

Harvest estimates show that creel rates have been declining since the first year of the fishery (Table 2). However, total harvest has remained at about 20 pounds of trout per surface acre; a very good harvest when compared to similar reservoirs and many warmwater fisheries. Data in past progress reports show that fishing pressure has generally increased through the years.

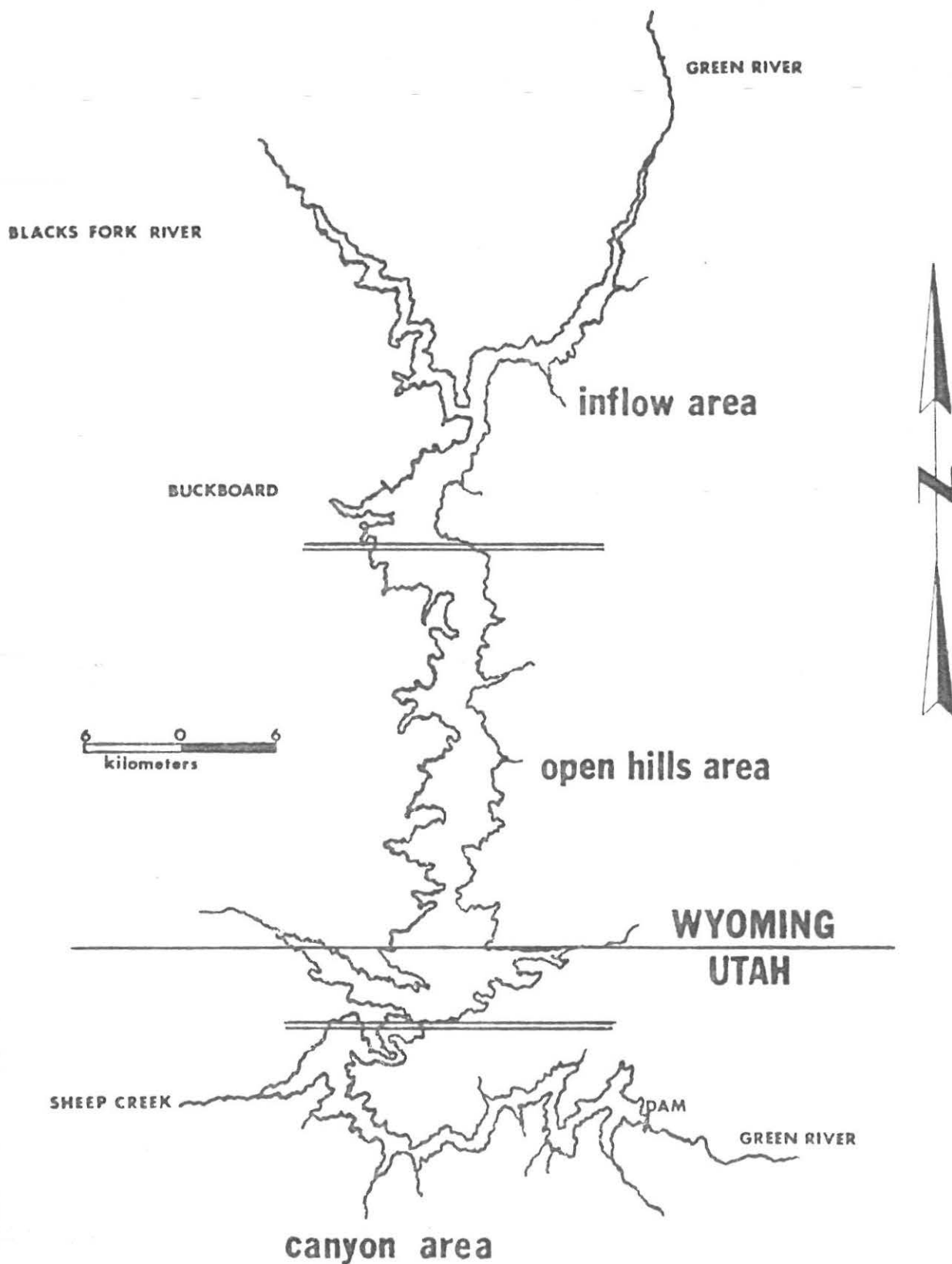


FIGURE 1 FLAMING GORGE RESERVOIR

Table 1. 1975 Flaming Gorge creel census summary with 1974 figures in parentheses. Percentages indicate change from 1974.

Area	Angler	Angler hours	Fish/hr	Harvest
Canyon	120,429 +5.2% (114,483)	495,830 +19.9% (413,710)	0.53 (0.51)	264,431 +26.2% (209,833)
Open hills	257,705 +2.2% (252,068)	1,066,866 +1.7% (1,049,472)	0.41 (0.50)	435,499 -16.5% (521,368)
Inflow	51,535 +3.5% (49,794)	187,208 -9.0% (205,762)	0.28 (0.33)	53,051 -21.9% (67,936)
Total	429,669 +3.2% (416,345)	1,749,625 +4.9% (1,668,669)	0.43 (0.49)	752,981 -6.1% (799,137)

Boat - Shore Fishing Relationship

Boat	260,154 +1.3% (256,781)	1,130,004 +6.6% (1,060,553)	0.50 (0.53)	559,297 -0.3% (561,123)
Shore	169,515 +6.2% (159,564)	619,621 +1.9% (608,391)	0.31 (0.39)	193,684 -18.6% (238,014)

Fish/Hour by Area and Boat-Shore

	Canyon	Open hills	Inflow
Boat	0.61	0.47	0.29
Shore	0.40	0.28	0.24

Table 2. Summary of trout harvest information, Flaming Gorge Reservoir, 1963-1975.

Year	Catch/hour	Est. Yield (lb/acre)	Mean Wgt. (lb.)	Acres Stocked	No. Stocked/acre
1963	-----	-----	-----	5,797	575
1964	1.23	18.2	-----	18,965	213
1965	1.28	20.8	0.54	20,762	78
1966	0.78	26.1	1.02	30,959	56
1967	0.62	24.5	1.05	28,579	79
1968	0.58	19.4	1.00	27,692	100
1969	0.56	19.2	0.90	25,291	116
1970	0.44	14.7	0.96	23,897	143
1971	0.40	8.0	0.95	31,103	132
1972	0.60	18.0	0.78	39,862	164
1973*	0.57	20.0	0.91	38,067	71
1974	0.49	20.0	0.86	38,100	68
1975	0.43	15.6	0.77	38,940	85

*First year 5 inch rainbow trout stocked.

Reasons for the continued decrease in catch rate are not readily apparent. The catch rate remained steady throughout the year except for a slight peak in June and July.

Mean size of rainbow trout creeled was 321 mm and 349 g. Brown trout averaged 332 mm and 431 g. The mean length and weight for brown trout may be underestimated since most large brown trout are creeled (during late fall and early spring) when creel census effort is light. Many large trout weighing more than 4.5 kg continue to be taken from Flaming Gorge enhancing the reservoir's "trophy fish" reputation.

Creel composition was as follows: rainbow trout, 95.1%; brown trout, 4.0%; lake trout, 0.6%; and cutthroat trout, 0.2% (Table 3). Other species comprising the remaining 0.1% were largemouth and smallmouth bass, kokanee salmon, carp, Utah chubs and mountain whitefish.

Lake trout comprised a greater portion of the creel, reflecting increased fisherman interest in this trophy species. The lake trout harvest, like the brown trout harvest, is underestimated since the majority of fish are caught during the lightly censused fall, winter, and early spring periods.

Table 3. Numbers of trout checked during 1975 Flaming Gorge Reservoir creel census with percentage composition in parentheses.

Month	Rainbow	Brown	Lake	Cutt
Jan. - Mar.	345 (93.0)	25 (6.7)	1 (0.3)	0
April	407 (92.1)	31 (7.0)	2 (0.4)	3 (0.5)
May	987 (95.2)	45 (4.3)	3 (0.3)	2 (0.2)
June	1,716 (95.3)	73 (4.1)	4 (0.2)	7 (0.4)
July	1,990 (95.7)	56 (2.7)	27 (1.3)	7 (0.3)
August	1,413 (97.8)	18 (1.2)	9 (0.6)	5 (0.4)
September	378 (94.0)	21 (5.2)	1 (0.2)	2 (0.6)
October	156 (83.3)	35 (16.7)	0	0
Nov. - Dec.	91 (82.0)	20 (18.0)	0	0

IMPACT OF MULTI-LEVEL OUTLETS ON
FLAMING GORGE RESERVOIR AND DOWNSTREAM WATERS

Job F-II

Since about 1967 the penstocks have taken water from increasingly deeper strata at Flaming Gorge Dam as the reservoir filled. This has resulted in a temperature regime in the tailwater which seldom exceeded 5.6°C (42°F) for nine months (Varley et al. 1970). In an attempt to alleviate this situation, a proposal is being considered to modify the penstocks at Flaming Gorge Dam to return the tailwaters to a more natural temperature regime.

Since current information on the reservoir's stratification patterns was not available, a one year study was initiated to document any recent changes within the reservoir and to determine the presence of density currents originating from the Green River.

Physical-chemical data were taken from three stations: the log barrier near the dam, Bear Canyon two miles from the dam, and Goose Necks twelve miles above the dam. In addition, temperature data taken from the upper reservoir were collected in an attempt to delineate the possible penetration of a density current down reservoir. Data collection began in April and ended in September.

The only significant change detected during the sampling was the apparent disappearance of the monimolimnion in the lower reservoir reported by Varley (1967). Varley reported that an oxygen devoid monimolimnion existed below about 45.7 m (150 ft) in the lower two miles of the reservoir. This situation has changed somewhat since oxygen was found clear to the bottom at all lower reservoir stations although values near the

bottom were low. Surface dissolved oxygen values ranged from 10.0 mg/l in April to 6.5 mg/l in September. Typically dissolved oxygen values were about 8.5 mg/l at the surface and decreased slowly to about 6 mg/l at 70 to 75 m (230 to 250 feet), then dropped sharply to 2 mg/l at 85 m (279 feet) and down to 0.5 to 1 mg/l at 90 to 100 m (295 to 328 feet) (Fig. 2). Negative heterograde oxygen curves were in evidence during late summer. No hydrogen sulfide was detected during sampling.

Other chemical constituents remained at seasonal levels comparable to previous years. Hydrogen ion concentration (pH) ranged from 8.6 to 8.8 at the surface down to 7.5 to 7.7 near the bottom and total alkalinity 130 to 180 mg/l. Strong stratification did not develop until late summer.

Temperature profiles indicated that a density current was discernable down to about the inflow area boundary. Below the inflow area the density current disappeared and the effects of the river were not detectable.

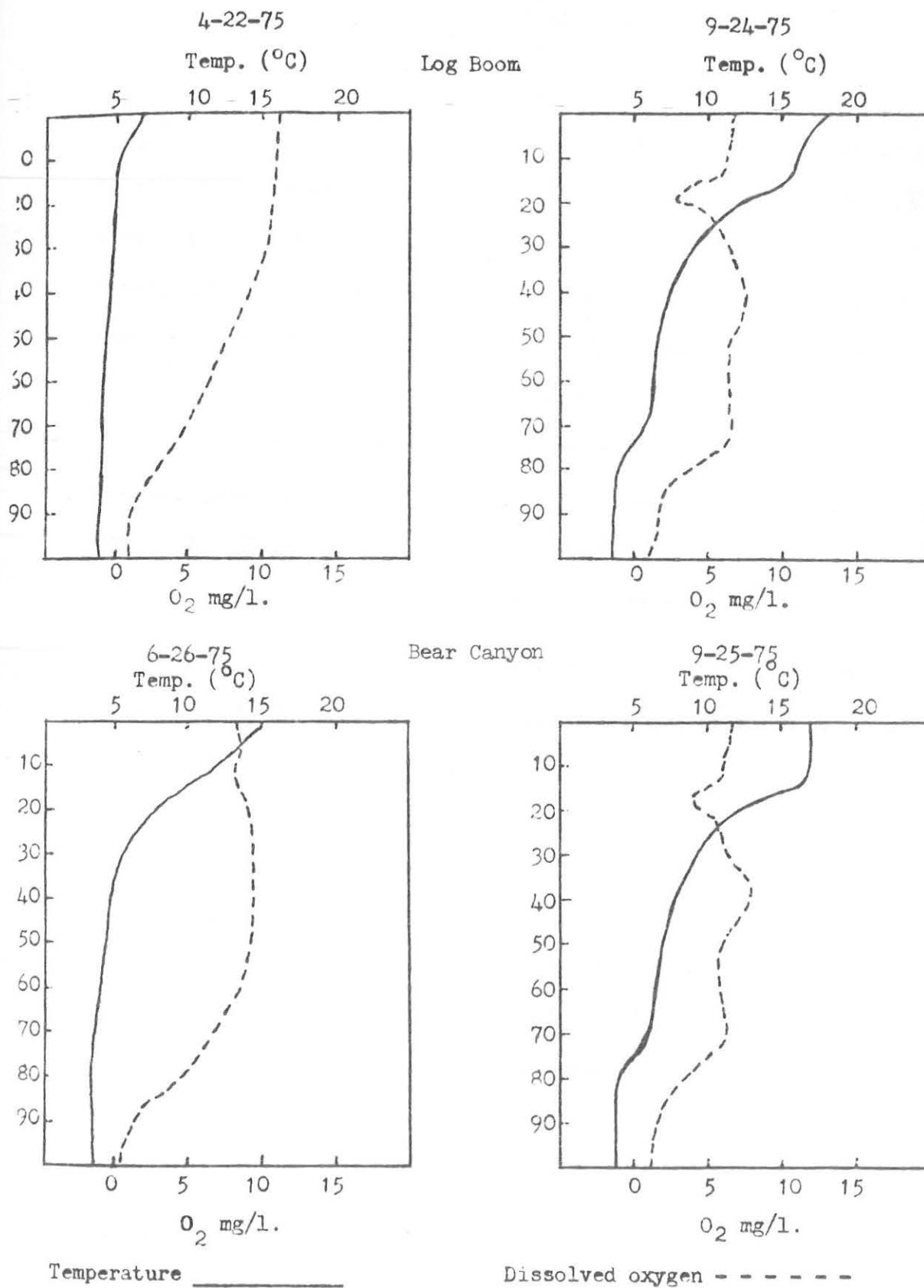


Figure 2. Selected temperature and dissolved oxygen profiles from Log Boom and Bear Canyon, Flaming Gorge Reservoir, 1975.

RESERVOIR FISH MARKING AND STOCKING

Job F-III

Insufficient natural recruitment of salmonids necessitates stocking of Flaming Gorge Reservoir to maintain the fishery. During 1975, 3,305,423 advanced trout fingerlings (127 mm TL) were stocked (Table 4). Of the total, 2,788,892 rainbow trout (71.6/acre) were stocked during the period, April through June, by direct plants at boat ramps and other access points. In addition, 516,531 brown trout (13.3/acre) were stocked in September using a planting barge to facilitate dispersal. Rainbow trout were stocked primarily in the canyon and open hills areas and brown trout in the warmer, relatively eutrophic inflow area. Stocking rates by area were canyon, 24.2%; open hills, 59.7%; and inflow, 16.1%.

Beginning in 1973 size of rainbow stocked was increased to five inches (Starostka et al. 1973, 1974). Comparing return of three inch rainbow (1972 plant) and five inch rainbow (1973 plant) shows a greater percentage return over three years for fish stocked at five inches (Table 5).

Greater returns of five inch fish are probably the result of increased fishing effort and associated harvest of younger, smaller fish with age I fish representing 60.9% of rainbow creel in 1975 (Table 6). If the rate of natural mortality is relatively constant, changes in survival will be associated with changes in fishing effort. Under these conditions returns of three and five inch rainbow may be similar.

Largemouth bass were stocked in an attempt to provide a summer fishery and to prey on littoral Utah chub populations. Four hundred-sixteen thousand six hundred and sixty fry were stocked in warm, littoral waters of the open hills area.

Table 4. -Fish stocking summary by species and agency for Flaming Gorge Reservoir, 1975.

Agency	Species	No Planted	Lbs Planted	No/lb
F+WS ¹	R B T ²	1,359,266	77,515	17.5
Utah	R B T	650,332	27,765	23.4
Wyoming	R B T	779,294	43,552	17.9
Total	R B T	2,788,892	148,832	18.7
F&WS	B N T ³	249,531	15,277	16.3
Wyoming	B N T	267,000	13,600	19.6
Total	B N T	516,531	28,877	17.9
F&WS ⁴	L M B	416,660	373	1,117.1
Utah	T F S ⁶	Estimated six million eggs and 1,000 adults		
1	Fish and Wildlife Service, Jones Hole National Fish Hatchery			
2	Rainbow trout			
3	Brown trout			
4	Fish and Wildlife Service, Cedar Bluff National Fish Hatchery			
5	Largemouth bass			
6	Threadfin shad			

Table 5. Comparison of returns from the 1972 plant of three inch rainbow trout and the 1973 plant of five inch rainbow trout, Flaming Gorge Reservoir.

Number planted (year)	Numbers returned by Age Class				Total number returned	% return
	0	1	2	P		
5,740,044 (1972)	23,288	382,540	334,838	0.203	740,666	12.9
2,266,903 (1973)	46,566	398,769	193,516	0.541	638,841	28.2

P = instantaneous rate of fishing mortality

Table 6. Percent age composition of the rainbow harvest from Flaming Gorge Reservoir, 1970 through 1975 by age groups.

Year	0	I	II	III	IV	V
1970	7.8	43.9	36.8	9.6	1.9	-
1971	5.5	62.3	22.3	8.0	1.4	0.4
1972	3.6	75.1	19.3	1.8	0.2	-
1973	6.0	49.3	41.4	2.7	0.6	-
1974	4.7	49.9	41.9	3.3	0.2	-
1975	5.2	60.9	25.7	7.7	0.5	-

Attempts to establish threadfin shad as a competitor to the Utah chub and forage for rainbow trout continued. Approximately six million eggs were transferred from Lake Powell by methods described previously (Starostka et al 1974). Eggs were allowed to hatch in Spring Creek Bay, a warm, turbid portion of the open hills area. Egg mats were transferred from a tank truck to a floating basket device which allowed escapement of shad but barred predators. Water temperatures were near optimum (21°C, 70°F). Hatching success appeared to be good.

In addition to threadfin shad eggs, approximately 1,000 spawning, adult shad were stocked in the same area. Threadfin shad were netted at Bullfrog Basin, Lake Powell during their spawning run and transported to Flaming Gorge by truck in a solution of common salt and tricaine methanesulfonate (Collins and Hulsey 1962). Survival of adult shad was excellent. All adult shad were active and disappeared into the warm, turbid water immediately despite a transportation time of up to eight hours.

In an attempt to determine survival of different stocks and movements of planted fish, about one-half of the trout fingerlings released in the reservoir were spray marked. Preliminary data show that marked fingerlings dispersed well. Additional data will be collected during 1976.

Six experimental gill nets were set in each of the three reservoir areas during April, August, and November. Nets were set for about 118 hours in each area. All fish have been captured at relatively constant rates since 1963 with the exception of rainbow trout, Utah chub, and white suckers (Tables 7, 8, 9). Catches of rainbow trout have declined since 1963 with the least decline in the canyon area. Utah chubs have been increasing in the net catch since 1963 and white suckers since 1969.

Table 7. Catch per gill-net hour of fish captured in the canyon area, Flaming Gorge Reservoir.

Species	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Rainbow trout	1.91	1.00	2.26	1.74	1.21	0.66	0.87	1.21	0.61	0.56	0.81
Brown trout				0.01	0.09	0.10	0.03	0.02	0.01	0.03	0.10
Cutthroat trout		0.01		0.04	0.09	0.02	0.05	0.02	0.01	0.01	0.06
Whitefish			0.01		0.04	0.01	0.02	0.02	0.01	0.03	0.02
Utah chub		0.17	0.98	0.46	5.01	8.36	1.81	1.65	2.10	3.20	3.42
Roundtail chub		0.02	0.01		0.06	0.01	0.02		0.01	0.01	0.02
Carp		0.01			0.01	0.01	0.03	0.02	0.01	0.01	
Flannelmouth sucker		0.13	0.15	0.11	0.17	0.16	0.22	0.21	0.11	0.24	0.14
Mountain sucker		0.03	0.12		0.07	0.05	0.01	0.02	0.01		
White sucker							0.01	0.08	0.23	0.65	2.04

Table 8. Catch per gill-net hour of fish captured in the open area, Flaming Gorge Reservoir.

Species	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Rainbow trout	1.76	0.90	1.47	1.76	1.06	0.59	0.70	0.79	0.19	0.37	0.19
Brown trout					0.12	0.23	0.07	0.04	0.15	0.09	0.18
Cutthroat trout		0.01	0.01	0.01	0.01	0.01	0.03		0.01		
Whitefish			0.01		0.02	0.03	0.02	0.04	0.02	0.08	0.08
Utah chub	0.12	0.22	4.52	1.22	7.57	1.35	6.93	4.41	2.15	2.42	5.54
Roundtail chub	0.01	0.05	0.04		0.05	0.01		0.01	0.02	0.02	0.02
Carp	0.03	0.01			0.05	0.01	0.02	0.03	0.03		0.10
Flannemouth sucker	0.19	0.29	1.17	0.21	0.44	0.22	0.18	0.22	0.60	0.31	0.02
Mountain sucker		0.04	0.09		0.11	0.10	0.06	0.02			
White sucker						0.01	0.08	0.31	0.21	0.39	1.34

Table 9. Catch per gill-net hour of fish captured in the inflow area, Flaming Gorge Reservoir.

Species	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
Rainbow trout	1.44	1.12	0.87	0.67	0.49	0.44	0.36	0.37	0.25	0.37	0.19
Brown trout	0.01	0.01	0.03	0.31	0.54	0.25	0.11	0.22	0.27	0.26	0.17
Cutthroat trout				0.01							
Whitefish	0.01		0.01	0.04	0.07	0.06	0.03	0.08	0.02		0.09
Utah chub	0.07	1.58	5.68	4.99	7.85	5.04	7.45	5.79	2.47	3.35	4.46
Roundtail chub	0.06	0.08	0.17	0.57	0.44	0.15	0.04	0.01	0.01	0.01	0.03
Carp	0.01	0.02	0.04	0.06	0.08	0.06		0.01	0.04	0.01	
Flannemouth sucker	1.10	1.90	1.87	1.23	0.58	0.49	0.32	0.41	0.20	0.16	0.07
Mountain sucker	0.01	1.01	0.11	0.01	0.11	0.02	0.03	0.06	0.07		0.01
White sucker					0.02	0.02	0.07	1.22	0.55	1.18	1.02

During 1969 and 1970 the nets appeared to be so full of chubs that effective fishing was thought to be impossible. After 1970 experimental nets were set somewhat farther offshore, generally in 15 feet or more of water, to reduce catches of Utah chub. The trend after 1970 shows chub populations in somewhat deeper water to be on the increase.

Relative to average size of trout in Flaming Gorge Reservoir, a trend toward smaller fish is suggested (Table 10). Generally smaller trout have been captured in the nets through the 1970's although there has been some variation.

Work through 1975 shows virtually the same food habit trends as indicated in earlier work (Starostka et al 1974). Rainbow fed primarily upon zooplankton and aquatic insects. Very few rainbow contain fish. Brown trout of all sizes feed primarily on Utah chub. Lake trout fed primarily on Utah chub (Table 11). The relatively high incidence of rainbow trout is probably due to time of sampling. A large portion of the stomachs sampled were taken during July, soon after the annual stocking period.

The growth of rainbow trout continues to be excellent (Table 12). The slight increase in size of age I rainbow in the 1974 year class reflects the stocking of five inch fingerling which began in 1973. The increase, however, is not as great as was expected. Evaluation of the five inch plants will continue as data from the 1975 year class are collected during 1976. Brown trout growth was similar to that in 1974 (Starostka et al 1974). An aging method using brachistegal rays (Bulkley 1967) is being initiated for lake trout since scales do not appear to provide reliable data.

Table 10. Mean total length (TL) of fish captured in gill-nets, Flaming Gorge Reservoir 1963-1975.

Year	Canyon Area					Open Area					Inflow Area				
	RBT	BNT	UTC	WS	RBT	BNT	UTC	WS	RBT	BNT	UTC	WS	RBT	BNT	UTC
1963	178.3				205.9		144.0		210.1						
1964	273.3				282.3				276.5		151.2				
1965	282.3				294.2		168.1		299.2		166.5				
1966	301.2		179.6		317.3		191.3		315.4		207.6				
1967	298.1				325.7				328.3		216.6				
1968	317.9	284.0	220.8		313.2	317.0	221.6		316.7	319.7	227.8				
1969	312.9	380.0	191.6		316.5	378.2	201.		320.4	347.9	228.5	343.0			
1970	290.7	422.8	203.3		310.8	409.8	215.4	415.0	266.1	418.3	223.7	293.8			
1971	270.0	398.0	211.1	270.0	296.8	419.9	219.5	306.3	240.2	443.8	219.4	312.1			
1972	295.9	562.0	208.1	328.6	317.7	336.0	229.9	336.4	265.6	395.7	158.5	291.3			
1973	285.6	334.8	210.3	291.1	337.0	474.3	216.1	356.1	313.5	350.5	234.5	344.4			
1974	261.5	419.5	164.5	315.8	285.4	398.0	211.9	288.0	256.9	357.3	219.1	345.5			
1975	264.5	446.8	204.7	259.6	310.7	436.1	224.5	217.3	278.9	382.9	236.3	407.2			

Table 11. Mean percent occurrence of food items in the stomachs of lake trout collected from Flaming Gorge Reservoir, Utah, 1974-1975. Number of stomachs examined in parentheses.

Food item	301-400	401-500	501-600	601-700	Total
Fish					
Utah chub	---	67.0 (2)	53.0 (10)	43.0 (3)	50.0 (15)
Rainbow trout	---	23.0 (1)	15.0 (3)	14.0 (1)	17.0 (5)
Unidentified	100.0 (1)	---	32.0 (6)	43.0 (3)	33.0 (10)
Non-fish	---	---	---	---	---
No. empty stomachs	0	2	7	3	12
Total No. examined	1	5	26	10	42

Table 12. Mean back-calculated TL of Flaming Gorge Reservoir rainbow trout, 1970-1975.

Canyon Area					
Year Class	Sample Size	Mean calculated TL (mm) at end of each year			
		1	2	3	4
1974	338	253			
1973	326	229	309		
1972	198	225	312	388	
1971	305	246	322	415	489
1970	331	241	347	372	
Mean calculated total length		239	323	392	489
No. of trout		750	353	22	1
Open Hills					
1974	510	278			
1973	597	276	346		
1972	357	256	344	407	
1971	139	278	351	396	487
1970	220	272	373	386	
Mean calculated total length		272	354	396	487
No. of trout		1,693	745	87	3
Inflow					
1974	80	264			
1973	93	288	342		
1972	179	274	364	437	
1971	113	263	365	413	
1970	92	280	402	399	502
Mean calculated total length		274	368	416	502
No. of trout		342	142	23	1

FLAMING GORGE TAILWATER CREEL CENSUS

Job F-IV

The objectives of this segment were to determine the magnitude and composition of the annual harvest from the Flaming Gorge tailwaters.

Harvest estimates projected from creel census data collected during 1975 is summarized in Table 13. The data show that 14,123 anglers fished 59,196 hours, harvesting 24,094 trout. This represented a creel rate of 0.41 fish per hour, compared to 0.64 in 1974. This reduced rate appeared to be related to high flows during June and July which reduced the susceptibility of fish to angling and heavier angling activity during 1974, a year of low flows and excellent fishing success. Monthly creel and catch rates for rainbow and Snake River cutthroat trout are presented in Table 14.

Angler use and effort decreased significantly on the upper section during 1975 because of loss of access to the tailrace raft launching area. As a result use in the lower section increased significantly. During 1975, 59.5 percent of the total angler use was expended above Little Hole; averaging 1,167 anglers per mile, while use below Little Hole averaged 255 anglers per mile. Table 15 provides a comparison of angler use and effort on the Green River tailwaters with that reported on other waters.

The estimated harvest of 24,094 trout was predominately rainbow trout (RBT); comprising 96.4 percent of the harvest in the upper section and 75.3 percent in the lower section (Table 16). The overall contribution of Snake River cutthroat (SRCTT) increased significantly from less than 3.5 percent in 1974 to 10.5 percent of the total harvest in 1975. Below Little Hole the contribution of SRCTT increased from less than 2.0

Table 13. Creel census summary, Green River tailwaters, 1975.

Month	Total Anglers	Hours	Harvest	Fish Per Angler Hour	Angler Day
Upper section ¹					
June	2,541	12,759	5,291	0.41	2.08
July	1,820	6,679	2,310	0.34	1.27
August	2,669	9,825	4,794	0.49	1.79
September	727	2,882	1,054	0.37	1.45
Oct.-Nov.	644	2,377	998	0.42	1.55
Total	8,401	34,522	14,447	0.42	1.72
Lower section ²					
June	1,157	6,884	2,743	0.39	2.37
July	1,099	5,016	1,531	0.30	1.39
August	1,345	4,987	2,045	0.41	1.52
September	690	3,007	1,287	0.43	1.87
Oct.-Nov.	1,431	4,780	2,041	0.43	1.43
Total	5,722	24,674	9,647	0.39	1.69
Grand Total	14,123	59,196	24,094	0.41	1.71

¹ Tailrace to Little Hole² Little Hole to Utah-Colorado border

Table 14. Comparison of creel and catch rates of Snake River cutthroat and rainbow trout, Green River tailwaters, 1975 (catch rates in parentheses).*

Month	<u>Location</u>					
	Tailrace		Little Hole		Brown's Park	
	RBT	SRCTT	RBT	SRCTT	RBT	SRCTT
June	.28 (.49)	<.01 (<.01)	.38 (.49)	<.01 (<.01)	.32 (--)	.06 (--)
July	.46 (.61)	<.01 (.04)	.41 (.65)	<.01 (<.01)	.07 (.15)	.06 (.12)
August	.82(1.68)	-- (---)	.52 (.85)	.01 (.02)	.18 (.33)	.14 (.53)
September	.33 (.66)	-- (---)	.28 (.34)	.03 (.03)	-- (--)	-- (--)
Oct.-Nov.	-- (--)	-- (---)	.43 (.72)	.02 (.02)	.16 (.16)	.26 (.29)

* Catch rate data based only on throwbacks anglers could identify.

-- Insufficient data

Table 15. A comparison of angling pressure (angler hours per mile) on the Green River tailwaters, Utah with other areas.

Angler hours per mile	River	Source
2,000	Flaming Gorge tailwaters (total), 1975	
4,795	Upper section	
1,101	Lower section	
974	Glen Canyon tailwaters, 1963 - 1972	Personal Corres., 1975
6,256	Navajo tailwaters, 1971	McNall, 1972
1,136	Fontenelle tailwaters, 1972	Banks et al. 1974

Table 16. Species composition of the harvest, Green River tailwaters, 1975 (percent in parentheses).

Species	Section		Total
	Upper	Lower	
RBT	13,922 (96.4)	7,266 (75.3)	21,188 (87.9)
SRCTT	414 (2.9)	2,106 (21.8)	2,520 (10.5)
YWCTT	94 (0.6)	25 (0.3)	119 (0.5)
BRK	17 (0.1)	74 (0.8)	91 (0.4)
BNT	-- ---	176 (1.8)	176 (0.7)
Total	14,447	9,647	24,094

RBT - rainbow, SRCTT - Snake River cutthroat, YWCTT - Yellowstone cutthroat,
BRK - brook, BNT - brown

percent in 1974 to 21.8 percent in 1975. Since 1971 379,107 SRCTT have been stocked in the Green River; 11.9 percent of which were stocked in 1974. The increased harvest of this species in 1975 appeared to result primarily from the return of the 1973 and 1974 age classes.

Other trout species contributing to the harvest included Yellowstone cutthroat, brown and brook trout.

Condition factors (K, TL) for rainbow and Snake River cutthroat trout harvested from May 31 to August 16, 1975 are presented for comparison in Table 17. Since the SRCTT sampled ranged from 200-400 mm in length, only RBT of comparable length were included for comparison. The values indicate that both species are suited to the environment of the tailwaters. Values recorded for RBT are comparable to values recorded for similar waters, while values for SRCTT are excellent. K factors of SRCTT recorded at Little Hole and Brown's Park are greater than average factors reported by Kiefling (1972) for endemic SRCTT (5.5-22.9 in.) and comparable to factors reported by Mullan (1975) for mestrophic reservoirs on the Uintah-Ouray Indian Reservation, Utah. The higher values recorded for both species in Brown's Park are attributed to better growth conditions resulting from more optimum water temperatures (Table 19).

Analysis of length data of fluorescent-marked fish sampled from angler creels provided information on the growth of 5 in (125 mm) rainbow trout fingerlings stocked during October 1973 - 1974 and recovered the following summer and fall (Table 18). The mean length of the 1974 age class fish from the upper section increased approximately 115 mm in twelve months for an average of 9.6 mm growth per month. Growth of trout below Little Hole (primarily within Brown's Park) was significantly greater. Average

Table 17. Condition factors (TL) (number of fish in parentheses) of fish collected from the Green River tailwaters, May 31-August 16, 1975.

Size mm	Species			
	Snake River cutthroat		Rainbow	
	Little Hole	Brown's Park	Little Hole	Brown's Park
200-250	1.01 (3)	1.01 (6)	1.08 (33)	1.16 (8)
251-300	.96 (12)	1.06 (25)	1.05 (37)	1.26 (13)
301-350	.98 (8)	.98 (8)	1.07 (29)	1.12 (16)
351-400	-- (--)	.94 (5)	.98 (12)	1.06 (20)

Table 18. Comparison of the average total length of age class I+ rainbow trout creeled from different river sections, Green River tailwaters, 1974-1975.

<u>Mean Total Length and Range in mm for each Month</u>					
Year	June	July	August	September	Oct.-Nov.
Upper section					
1974	---	214 (186-230)	220 (185-284)	---	---
1975	254 (193-325)	219 (192-258)	206 (177-256)	216 (194-255)	240 (225-270)
Lower section					
1974	---	274 (252-314)	277 (204-305)	---	---
1975	---	---	276 (241-309)	---	---

Table 19. Average monthly recorded river temperatures, Green River tailwaters, 1974.

Month	Upper Section		Lower Section
	Below Dam	Little Hole	Sears Creek Brown's Park
May	39°F	43°F	46°F
June	40°F	45°F	48°F
July	42°F	51°F	52°F
August	44°F	48°F	49°F
September	45°F	47°F	49°F

fingerling size increased approximately 150 mm within 10 months for an average of 15 mm per month. This improved growth may have been related to warmer river temperatures within this section which provided better conditions for growth (Table 19). Growth appeared to be relatively stable from July through September in both river sections. A resurgence of growth during October - November appeared to be related to warmer water temperatures during this period.

A stratified sample of length measurements were taken from rainbow trout harvested during the 1975 fishing season. The average-size rainbow trout harvested increased progressively down-river. Fish creeled at the tail-race averaged 270 mm, Little Hole 279 mm, and Brown's Park 355 mm (Table 20). Seasonally the average size rainbow harvested at Little Hole declined steadily from 318 mm in June to 247 mm during October and November while the average size rainbow harvested below Little Hole remained relatively constant (337 to 386). The decline in average size at Little Hole appears to be due to both high angler exploitation (Table 15) and low water temperatures which suppress growth (Table 19). The average size Snake River cutthroat harvested remained more constant throughout the season in each section.

A comparison of length-frequency data for rainbow trout harvested for the entire tailwaters shows that the 1975 length data are comparable with data for the 1970-1975 period (Table 21). Since 1969 the percent occurrence of smaller-sized fish has increased despite declining angler use and effort (Table 22). This decline in average size has been attributed to marginal conditions for growth related to cooler water temperature experienced since 1968.

Table 20. Monthly average length (mm) of creoleed rainbow and Snake River cutthroat, Green River tailwaters, 1975 (Sample size in parentheses).

Month	Section						Total
	Tailrace		Little Hole		Brown's Park		
	RBT	SRCTT	RBT	SRCTT	RBT	SRCTT	
June	276 (50)	-- --	318 (125)	297 (11)	386 (62)	294 (23)	322 (237) 295 (34)
July	258 (46)	-- --	286 (150)	285 (3)	337 (14)	310 (5)	283 (210) 301 (8)
August	280 (26)	-- --	253 (172)	260 (11)	341 (42)	281 (27)	271 (240) 281 (38)
September	-- --	-- --	241 (24)	-- --	-- --	326 (5)	-- -- --
Oct.-Nov.	-- --	-- --	247 (15)	-- --	-- --	-- --	-- -- --
Ave.	270(122)	-- --	279 (486)	288 (25)	355(118)	292 (60)	292 (726) 289 (85)

Table 21. Percent length-frequency distribution of rainbow trout, Green River tailwaters, 1967-1975.

Length (mm)	1967	1968	1969	1970	1971	1972	1973	1974	1975
144				0.3	0.3				1.1
145-164		0.8		0.6				0.9	0.4
165-184		0.8		0.3	0.5			3.8	4.3
185-204		0.8	0.5	1.5	3.2			9.3	9.7
205-224	2.8	2.4	2.8	6.4	5.1			10.3	12.0
225-244	7.9	0.8	4.6	10.1	9.6		3.5	17.2	9.5
245-264	4.7	3.2	3.7	16.7	16.8		11.1	16.3	9.0
265-284	6.8	6.4	4.2	15.4	15.5		21.5	12.2	12.2
285-304	4.7	13.6	5.5	10.1	10.7		9.7	9.3	10.0
305-324	10.7	11.2	5.5	8.0	5.9		2.8	6.3	9.3
325-344	10.0	14.4	5.5	2.1	7.5		3.5	4.9	7.7
345-364	7.1	8.0	13.8	2.8	4.5		7.6	1.8	5.0
365-384	8.4	5.6	14.3	4.0	4.8		4.1	2.6	3.6
385-404	15.0	8.8	10.6	4.9	4.8		7.6	1.8	2.2
405-424	12.3	6.4	18.7	4.9	1.9		3.5	0.2	1.6
425-444	5.2	8.0	5.5	2.8	1.9		6.9	0.5	0.6
445-464	2.0	3.2	4.6	3.4	2.9		6.3	0.4	0.5
465-484	2.4	4.0	3.7	4.9	2.1		3.5	1.1	0.4
485-504		1.6	4.6	1.5	2.4		2.1	0.9	0.5
505-524			2.3	0.9	1.9		2.8	0.2	0.2
525-544			1.4	1.5	0.5		0.7	0.2	0.1
545-564			1.4	0.6	0.8		2.8	0.2	0.1
565+				1.2	1.2				
Total number measured	253	125	217	326	375		144	551	821
Average (mm) size	340	345	386	295	312		356	285	292

Table 22. Comparison of angler use and effort estimates, Green River tailwaters, 1967-1975.

Estimated anglers (angler hours) per mile			
Year	Upper section (7.2 Miles)	Lower section (22.4 Miles)	Total (29.6 Miles)
1964	-- (--)	-- (--)	98 (301)
1965	-- (--)	-- (--)	277 (720)
1966	-- (--)	-- (--)	402 (1,331)
1967	3,587 (10,537)	339 (2,168)	939 (4,202)
1968	3,793 (10,232)	339 (2,269)	1,179 (4,206)
1969	2,920 (6,762)	204 (1,376)	865 (2,679)
1970	3,199 (10,278)	289 (1,591)	995 (1,466)
1971	1,812 (5,079)	170 (1,015)	570 (2,003)
1972	2,377 (6,944)	301 (1,882)	806 (3,113)
1973	1,790 (6,363)	211 (638)	595 (2,384)
1974	1,769 (5,690)	178 (705)	565 (1,917)
1975	1,167 (4,795)	255 (1,101)	477 (2,000)

River Flows

Mean monthly discharges in acre feet per day for 1964-1975 are presented in Table 23. During 1975 monthly discharges varied considerably, with record monthly releases during June and July diminishing to below average flows during September and October. Flows stabilized to near normal during November. The pattern of flow and amount of discharge appeared to influence angler use and effort more than the catchability of trout. Traditionally, June and July are the months of highest angling pressure but during 1975 angling pressure peaked in August as flows diminished (Table 23). Monthly creel rates varied considerably but did not appear to be correlated with monthly discharge.

Table 23. Mean daily discharge flows (acre feet/day), Green River tailwaters, 1963-1975.

Year	June	July	Aug.	Sept.	Oct.	Nov.	Mean
1964	2,907	4,818	3,955	4,255	4,821	4,572	4,221
1965	2,934	969	1,000	1,474	2,544	3,971	2,149
1966	3,120	3,415	3,856	4,046	3,959	2,800	3,533
1967	6,455	5,501	6,023	6,045	6,232	5,487	5,957
1968	3,392	6,478	6,552	6,140	4,630	4,680	5,312
1969	3,649	5,155	6,368	5,855	4,405	4,474	4,984
1970	3,030	3,988	4,317	3,999	2,059	2,404	3,299
1971	3,374	3,841	5,017	4,707	3,961	5,777	4,363
1972	6,438	6,037	5,459	3,199	6,214	7,112	5,743
1973	6,057	5,321	6,925	5,353	4,708	5,048	5,568
1974	4,424	2,863	4,603	4,683	5,826	4,898	4,594
1975	6,944	8,783	6,450	3,179	2,914	4,318	5,431
11 yr. mean	4,793	5,197	5,502	4,812	4,752	5,049	--

Source - Bureau of Reclamation Hydrometeorological Data

TAILWATER FISH STOCKING AND MARKING

Job F-V

During 1975 a total of 327,705 rainbow and 31,954 Snake River cutthroat fingerlings averaging 125 mm TL were stocked at the tailrace and Little Hole areas of the river for a stocking rate of 490 fingerling per surface acre on the total river reach in Utah. In addition, 5,138 catchable rainbow averaging 250 mm TL were stocked above Little Hole. In total 20,139 pounds were stocked, averaging 27.4 pounds per acre. A total of 16,452 pounds of trout were harvested representing a yield of 0.25 pounds of trout per angler hour and 22.4 pounds per surface acre.

Movement

Since 1966-1967 the temperature of water discharged from Flaming Gorge Dam has decreased significantly, while the normal discharge volume has increased. Concurrently, survival and return of fingerling trout have declined substantially.

During 1975 an investigation was conducted to determine the timing and relative magnitude of downstream movement of fingerlings stocked at Little Hole during October, 1974 and 1975. Three sampling stations were established on side-channels of the river within Brown's Park and sampled by electroshocking six times during the study period (Table 24). Downstream movement was indicated by changes in the percent composition of marked Age I+ fish at each station. Results indicated that marked fingerlings had reached Brown's Park within one month, a downstream distance of 12.5 to 20.0 miles. Within seven months, these fingerlings were recaptured at Island Park, 72.7 miles below the tailrace, and in Ashley Creek, 102.5 miles downstream demonstrating significant downstream drift of fingerlings out of the tailrace area. Peak numbers of 1974

Table 24. Estimated number of marked rainbow trout fingerling per 1,000 feet of side-channel, Brown's Park Green River tailwaters, 1975-1976.

Station	Year Class	Estimated number per 1,000 feet (Date sampled)					
I	1974	(1-22-75)	(3-30-75)	(4-10-75)	(7-26-75) ¹	(11-12-75)	(1-28-76)
		37	1	1	0	0	0
	1975	--	--	--	--	--	2
	Other trout ⁴	43	4	1	1	27	27
II	Total trout	80	5	1	1	29	29
	1974	35	13	16	2	0	0
	1975	--	--	--	--	13	6
	Other trout	236	83	51	12	91	37
III	Total trout	271	96	77	14	104	42
	1974	2	26	0	3	0	2
	1975	--	--	--	--	163	--
	Other trout	--	58	23	--	152	--
	Total trout	--	84	23	--	315	--

1. Estimate low because of high water conditions
2. Channel covered with ice, unable to shock
3. No sample
4. Other trout included brown trout, brook trout, Snake River cutthroat and unmarked rainbow trout

stocked fish were recovered at Brown's Park during January and March, 1975, declining through the remaining spring and summer months. Sampling of 1975 stocked fingerlings recovered peak numbers at Brown's Park in November, one month following stocking.

This high rate of movement was probably the result of cold-water temperature although high stocking rates may have had some influence also. Newell (1958) and Cooper (1953) noted that brook and rainbow trout planted when water temperatures were less than 50°F exhibited an immediate downstream movement while fish planted at temperatures above 50°F showed little movement. Average water temperatures do not exceed 50°F at the tailrace and reach 50°F at Little Hole only during October and November.

INTERSPECIFIC RELATIONSHIPS OF THE WHITE SUCKER

IN FLAMING GORGE RESERVOIR

Job F-VI

White suckers were first captured in 1969 and have been increasing in the gillnet catch of all areas since that time. Concern that white sucker (Catostomus commersoni) were competing directly with rainbow trout precipitated this study to determine to what extent competition may be occurring.

Data were taken from past years gillnetting information and were supplemented with gillnetting specifically for white sucker. Data concerning length, weight, and condition factors are summarized in Table 25. Food of white suckers was primarily chironomid larvae with trace amounts of zooplankton and molluscs (snails). Aging of white suckers was explored but revealed erratic growth patterns. Assignment of age classes could not be made with confidence. Past gillnetting data showed a corresponding decline of flannelmouth suckers (Catostomus latipinnis) over about the same period as the increase in white suckers, suggesting that the white sucker may be the direct competitor of this species. Middleton (1969) reported a similar phenomenon in Blue Mesa Reservoir where white suckers hybridized with flannelmouth suckers and eventually led to the disappearance of flannelmouth suckers. Direct competition between white suckers, rainbow trout and Utah chub appeared to be minimal since both rainbow trout and Utah chub feed primarily on zooplankton. There is no reason to believe that white suckers are valuable as forage since no white suckers have been taken from trout stomachs. The white suckers' greatest impact may be competition for space.

Table 25. Mean length, weight and condition of white suckers taken from gill nets, 1969-1975, Flaming Gorge Reservoir.

Year	Number	\bar{X} TL (mm)	\bar{X} wgt (g)	Area	K (SL)
1969	4	343	502	Inflow	2.06
1970	6	347	607	Open	2.39
1971	42	314	460	Open	2.44
1972	10	341	520	Canyon	2.15
	108	333	521	Open	2.32
	69	292	335	Inflow	2.22
1973	44	295	355	Canyon	2.27
	43	362	646	Open	2.23
	34	345	490	Inflow	1.97
1974	27	313	429	Canyon	2.31
	64	350	622	Open	2.35
	41	347	541	Inflow	2.13
1975	170	240	275	Canyon	2.97
	141	346	539	Open	1.96
	72	344	572	Inflow	2.10

Additional data on habitat, food habits, and age-growth will be collected during 1976 in an attempt to more precisely define the role of white suckers in Flaming Gorge Reservoir.

LITERATURE CITED

- Banks, R. L., J. W. Mullan, R. W. Wiley, and D. J. Dufek. 1974. The Fontenelle-Green River trout fisheries - considerations in its enhancement and perpetuation, including test flow studies of 1973. Bureau of Sport Fisheries and Wildlife, Dept. of Interior, Salt Lake City, Ut. 74 p.
- Bulkley, R. V. 1957. The use of branchiostegal rays to determine age of lake trout, Salvelinus namaycush Walbaum. M. S. thesis, Utah State University. 32 p.
- Collins, J. L. and A. H. Hulsey. 1962. Reduction of threadfin shad hauling mortality by the use of M. S. 222 and common salt. Ark. Game and Fish Comm. Mimeo. 3 p.
- Cooper, Edwin L. 1952. Returns from plants of legal-sized brook, brown and rainbow trout in the Pigeon River, Otsego County, Michigan. Trans. Amer. Fish. Soc. 82:265-280.
- Kiefling, John W. 1972. Characteristics of the Snake River trout population. M. S. thesis. University of Wyoming, Laramie. 54 p.
- Middleton, W. H. 1969. Hybridization and distribution of Catostomid fishes in Blue Mesa Reservoir and the upper Gunnison River drainage. M. A. thesis, Western State College of Colorado. 121 p.
- Mullan, J. W. 1975. Condition (K) as indicative of non-suitability of Snake River cutthroat trout in the management of high gradient, low diversity streams. Proc. Western Assoc. of State Game and Fish Comm. Seattle, Washington.
- McNall, Warren. 1972. Challenges on the San Juan. New Mexico Wildlife magazine. Sept.-Oct. 22-25 pp.
- Newell, Arthur E. 1958. Trout stream management investigations of the Swift River watershed in Albany, New Hampshire. New Hampshire Fish and Game Dept. Survey Report No. 7, 40 pp.
- Starostka, V. J., B. Nielsen and R. Stone. 1973. Flaming Gorge Reservoir and the Green River Tailwaters. In. Colorado River Drainage Reservoirs and tailwaters fisheries management, investigations, and surveys. Annual Progress Report Fed. Aid in Fish Restoration, F-28-R-2. Utah Division of Wildlife Resources. 27 p.
- Starostka, V. J., G. Wilson, R. W. Wiley, and D. J. Dufek. 1974. Flaming Gorge Reservoir and Green River post-impoundment investigations, Annual Performance Report Fed. Aid in Fish Restoration. Utah Division of Wildlife Resources. 24 p.

Varley, J. D. 1967. Plankton periodicity as related to the chemical, physical and biological environment of Flaming Gorge Reservoir Utah-Wyoming. Utah State Division of Fish and Game. Publ. No. 67-6. 192 p.

Varley, J. D., A. F. Regenthal, B. Nielsen, R. W. Wiley, F. W. Jackson, and D. J. Dufek. 1970. Green River and Flaming Gorge post-impoundment investigations. Utah State Division of Wildlife Resources. Progress Report No. 7. 27 p.

Prepared by:


Victor Starostka, Project Leader

Approved by:

Utah Division of Wildlife Resources


Chief of Fisheries


Federal Aid Coordinator

Date June 2, 1977

Archives Approval Number: 7600245