

State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

STANDING STOCKS OF FISHES
IN SECTIONS OF BIG GRIZZLY CREEK
PLUMAS COUNTY, 1994

by

Charles J. Brown

Bay-Delta and Special
Water Projects Division

1995

STANDING STOCKS OF FISHES IN SECTIONS OF BIG GRIZZLY CREEK, PLUMAS COUNTY, 1994

INTRODUCTION

The Department of Water Resources (DWR) initiated an instream flow program in 1976 to identify streams that would benefit from flow enhancement, to assess instream values, and identify actions such as habitat manipulation that could enhance these streams. The Northern District of DWR selected Big Grizzly Creek below Lake Davis (Figure 1) as one of the streams to study under this program.

Previous sampling effort on Big Grizzly Creek has been conducted by Department of Fish and Game (DFG) biologists. Initial estimates of rainbow trout (Oncorhynchus mykiss) populations were made by the DFG in 1976 (Brown 1976). The DFG also surveyed the creek in 1981, 1986, 1988 and 1991 to estimate standing stocks of brown trout (Salmo trutta) and rainbow trout in selected stations (Bumpass et al. 1989, Brown 1991a, Brown 1991b, and Brown 1992).

The objective of this study is to estimate the number, age, and growth of trout in stations established in 1976. The stations were originally established to set baseline conditions with which future changes in seasonal stream flow or other elements of habitat would be compared. A report discussing twenty-five years of fisheries studies on Big Grizzly Creek is scheduled to be prepared in the year 2001.

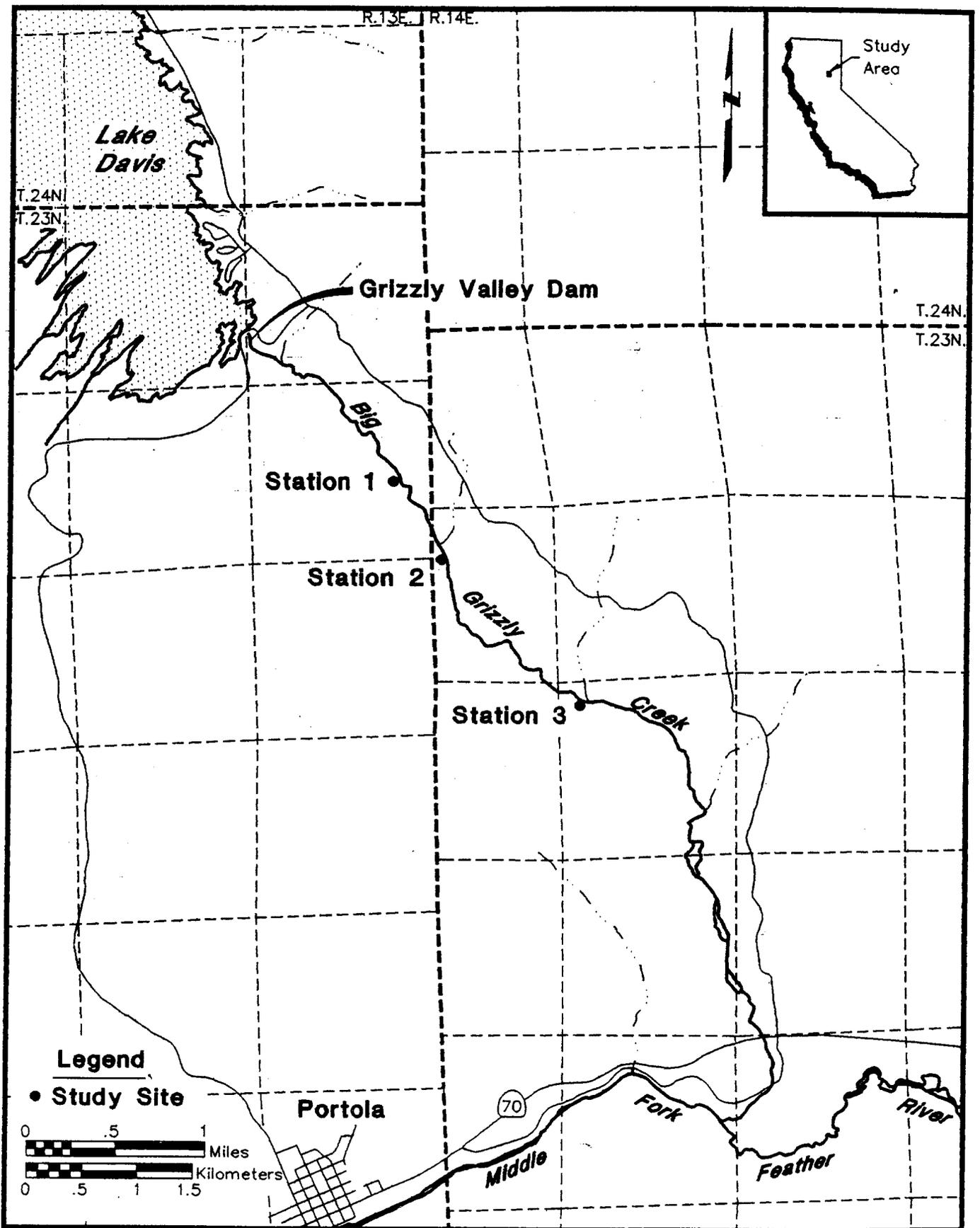


Figure 1. Stations sampled to estimate standing crop of trout in Big Grizzly Creek, 1994.

NAMES OF FISHES

The following species of fishes were caught in this study: rainbow trout, brown trout, and Sacramento sucker (Catostomus occidentalis).

METHODS

Physical Measurements

Standing stocks of fishes were estimated at four stations in Big Grizzly Creek (Figure 1). Stations were intentionally selected to be near stations sampled in previous DFG studies (Gerstung 1973). Markers had previously been placed in trees along the stream to identify station boundaries. Stations varied in length from 44.8 to 99.7 m (Appendix 1). The length and width of each station was measured with metric tape measures. The depth of water was determined by measuring water depth at the center of five equally spaced intervals across five transects at each station.

Biological Measurements

Fish were captured with a battery-powered backpack electroshocker in stream sections blocked by seines as described by Platts et al. (1983). Captured fish were removed from the net-enclosed section on each pass. Standing stock estimates were developed using the two-count method of Seber and LeCren (1967) or the multiple-pass method of Leslie and Davis (1939) with limits of confidence computed using a formula proposed by DeLury (1951).

The weights of trout were measured by displacement. Fork length (FL) of each fish caught was measured to the nearest millimeter.

Scale samples were taken from brown trout and rainbow trout over 100 mm in length. Scales were taken just above the lateral line between the dorsal and adipose fin (Scarnecchia 1979) and placed in a piece of paper inserted in a small coin envelope (Drummond 1966). Scales were mounted dry between microscope slides, and their images were projected on a NCR microfiche reader at a magnification of 42x. Scale measurements for the calculation of growth were recorded to the nearest millimeter along the anterior radius of the anterior-posterior axis of the scale. Estimation of instantaneous population growth rate was calculated (Ricker 1975) with significant values of correlation coefficients taken from a table (Steel and Torrie 1960).

$$\text{Instantaneous population growth rate} = b(\log_e l_2 - \log_e l_1)$$

b = between ages functional slope

l_1 = initial length for the last complete year of growth

l_2 = final length for the last complete year of growth

Standing crops of brown trout and rainbow trout were calculated for individual stations where each species was caught and then combined for the entire creek. Age and growth was calculated for the population (Everhart et al. 1975). Length-weight relationships were determined for both brown trout and rainbow trout (Lagler 1956). The coefficient of condition and 95 percent confidence intervals were calculated for all trout (Carlander 1969).

Distribution of all fish caught is listed according to location.

RESULTS

Distribution

Rainbow trout were caught in each station. Brown trout, rainbow trout, and Sacramento suckers were caught in station 4, the lowest station sampled (Table 1).

TABLE 1. Distribution of Fishes in Sections of Big Grizzly Creek Plumas County, 1994.

	Station Number			
	1	2	3	4
Distance below Grizzly Valley Dam (km)	2.5	3.2	4.8	9.7
Brown trout			X	
Rainbow trout	X	X	X	X
Sacramento sucker			X	

Standing Crop

Rainbow trout was the most common game fish caught in Big Grizzly Creek. Biomass averaged 2.2 g/m² in four stations (Table 2). Catchable rainbow trout (≥ 127 mm FL) biomass averaged 1.9 g/m². We found brown trout in only one station. Biomass in that station was 2.6 g/m² (Table 3). Catchable brown trout (≥ 127 mm FL) biomass was 1.9 g/m². Biomass was not estimated for Sacramento suckers.

Table 2. Estimate of rainbow trout standing crop in Big Grizzly Creek, Plumas County, 1994.

Distance Below Grizzly Valley Dam (km)	Population Estimate	95% Confidence Interval	Biomass (g/m ²)	Estimate of Catchable Trout (\geq 127 mm FL)	Biomass of Catchable Trout (g/m ²)
2.5	30	27-38	3.5	13	3.0
3.2	26	23-35	3.2	14	2.9
4.8	13	13-15	1.8	8	1.7
9.7	13	12-19	0.1	0	0

Table 3. Estimate of brown trout standing crop in Big Grizzly Creek, Plumas County, 1994.

Distance Below Grizzly Valley Dam (km)	Population Estimate	95% Confidence Interval	Biomass (g/m ²)	Estimate of Catchable Trout (\geq 127 mm FL)	Biomass of Catchable Trout (g/m ²)
9.7	51	48-58	2.6	9	1.9

Length and Weight

Age group 0+ rainbow trout represented 55 percent of the 93 rainbow trout caught. Ages 1+ and 2+ comprised 38 percent and 7 percent respectively (Figure 2 and Appendix 2). Age group 0+ brown trout made up 83 percent of the 48 brown trout caught. Ages 1+ and 2+ comprised 11 percent and 6 percent respectively (Figure 3 and Appendix 3).

The relationship between fork length (L) and weight (W) of rainbow trout for Big Grizzly Creek is:

$$\text{Log}_{10}W = -4.7 + 2.9 \text{Log}_{10}L$$

$$r^2 = 0.99$$

$$N = 93 \text{ (Figure 4 and Appendix 4)}$$

The same relationship for brown trout is:

$$\text{Log}_{10}W = -4.6 + 2.8 \text{Log}_{10}L$$

$$r^2 = 0.99$$

$$N = 48 \text{ (Figure 5 and Appendix 5)}$$

Age and Growth

The formula $L = 67.1 + 4.2 S$ describes the relationship between the fork length (L) and enlarged scale radius (S) of 38 rainbow trout caught in Big Grizzly Creek. The coefficient of correlation (r^2) is 0.47. The formula was $L = 143.4 + 1.3 S$ for 7 brown trout, while the value for r^2 is 0.19.

Population growth and mean individual growth were greater for brown trout than rainbow trout (tables 5 and 6).

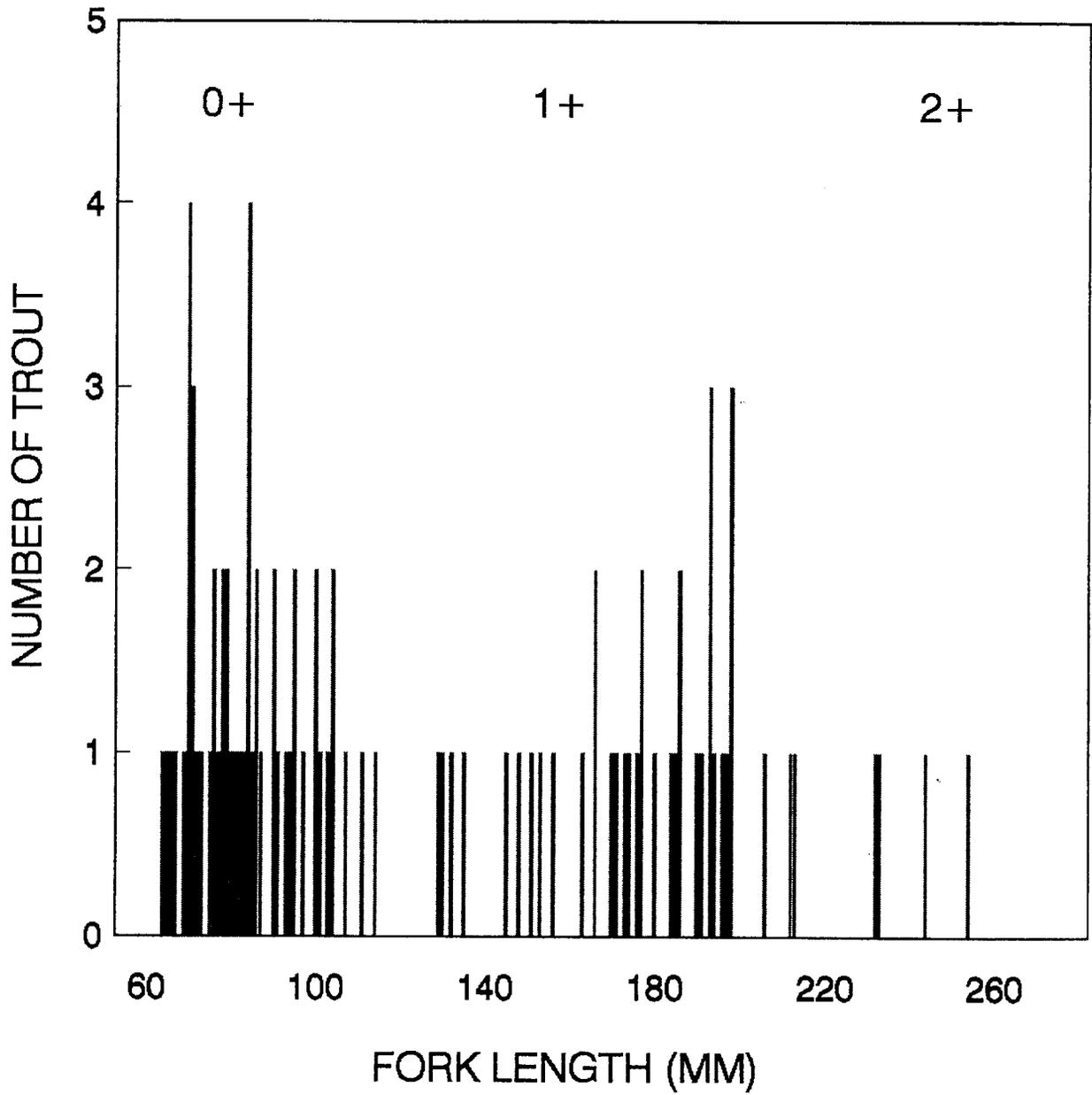


FIGURE 2. Length, observed frequency, and age of rainbow trout caught in Big Grizzly Creek, Plumas County, 1994.

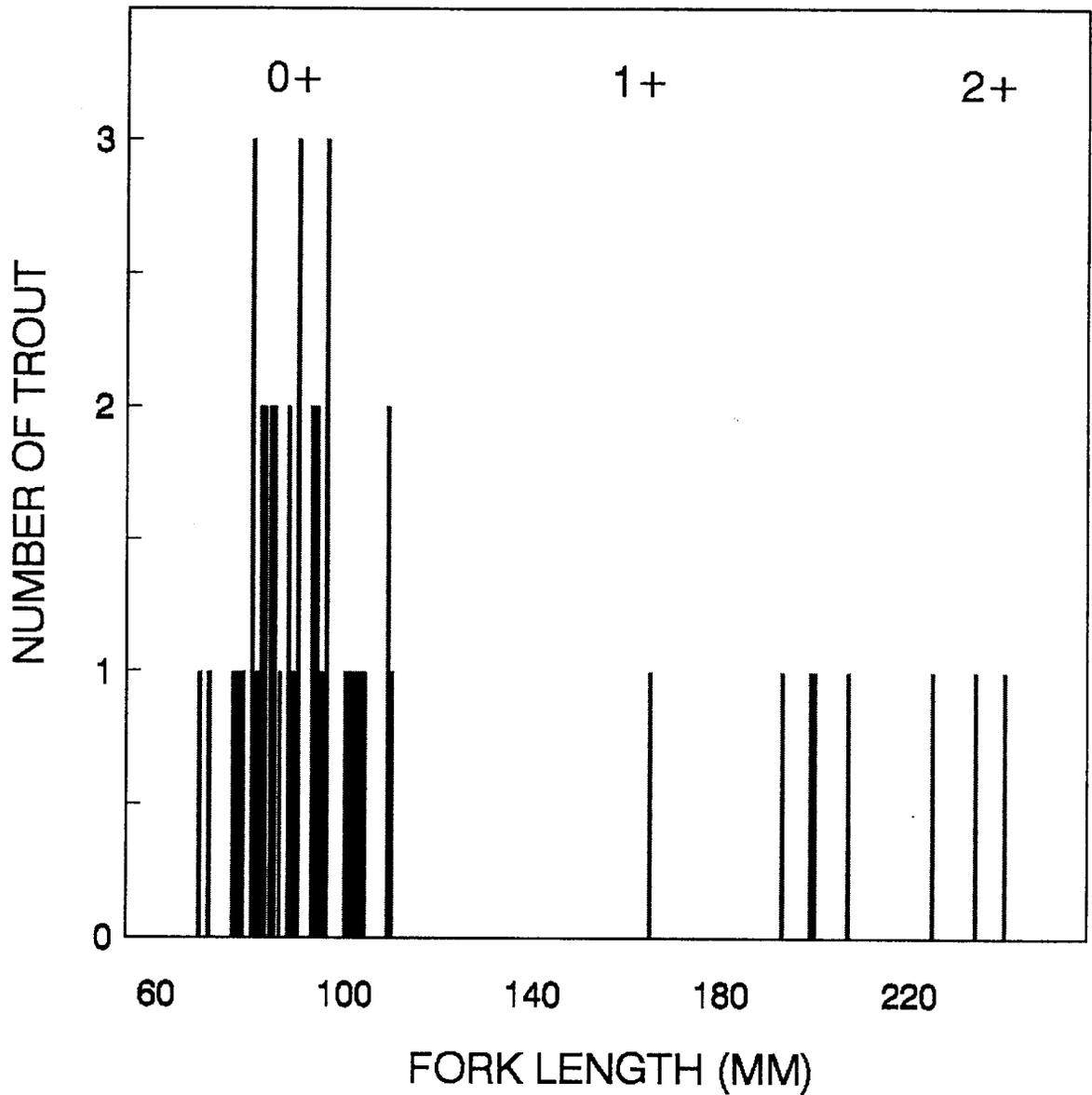


FIGURE 3. Length, observed frequency, and age of brown trout caught in Big Grizzly Creek, Plumas County, 1994.

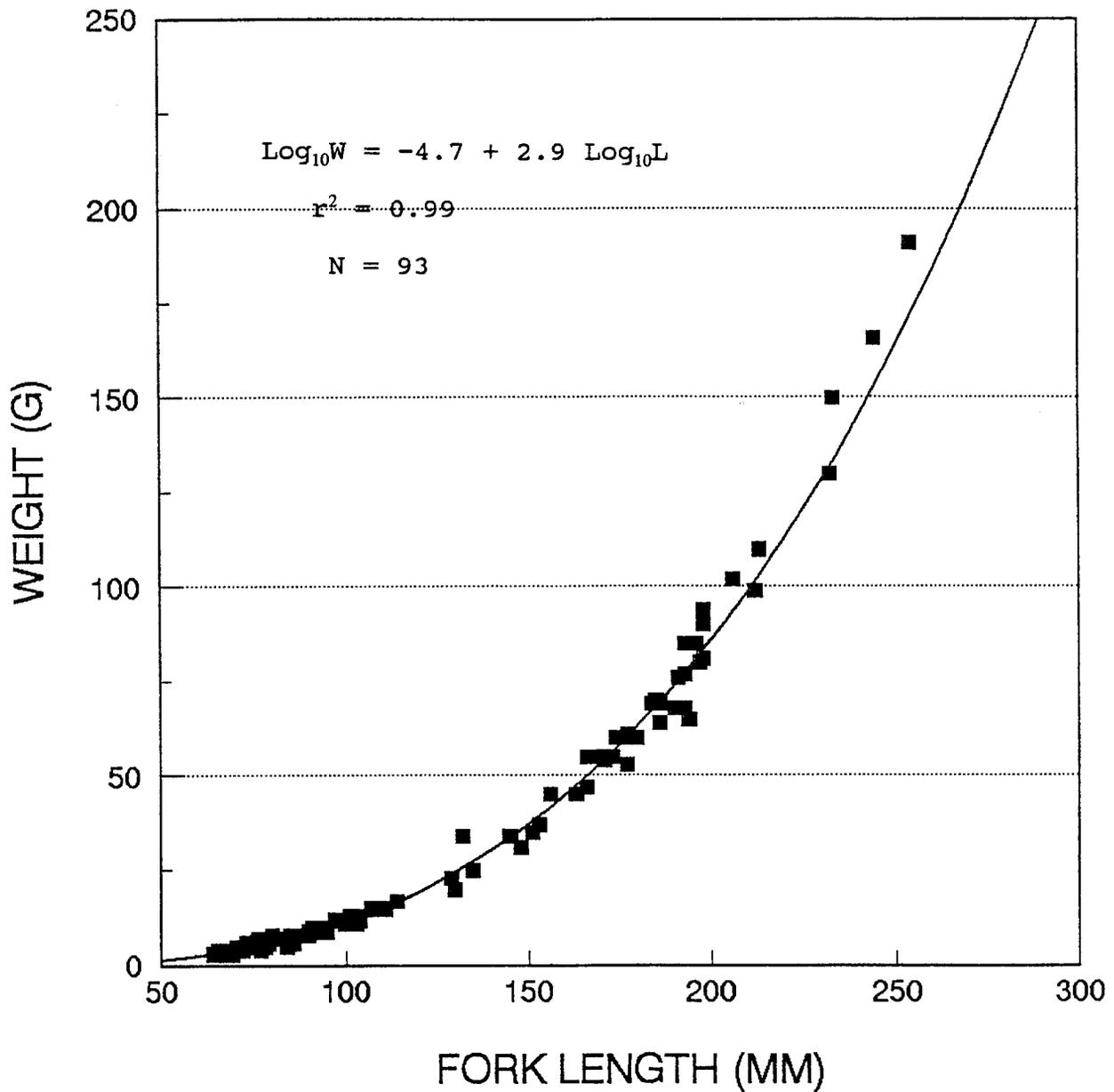


FIGURE 4. The relationship between length and weight of rainbow trout caught in sections of Big Grizzly Creek, 1994.

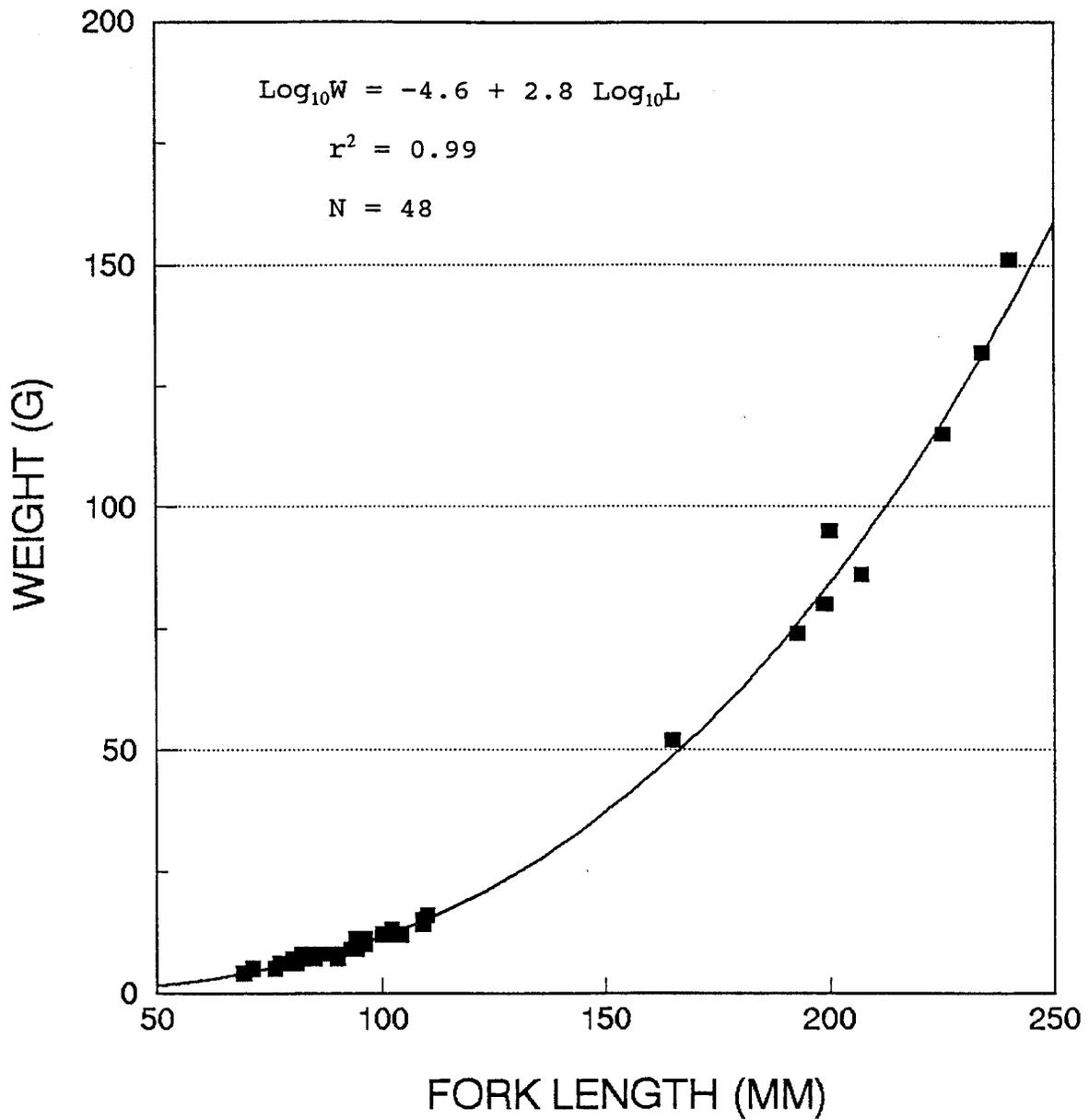


FIGURE 5. The relationship between length and weight of brown trout caught in sections of Big Grizzly Creek, 1994.

Table 5. Growth rates for rainbow trout caught in Big Grizzly Creek, 1994.

Age	Population Growth			Mean Individual Growth		
	Length Interval (mm)	Difference of Natural Logarithms	Instantaneous Growth Rate Gx	Length Interval (mm)	Difference of Natural Logarithms	Instantaneous Growth Rate Gx
1-2	100-179	0.582	1.747	95-179	0.634	1.901

Table 6. Growth rates for brown trout caught in Big Grizzly Creek, 1994.

Age	Population Growth			Mean Individual Growth		
	Length Interval (mm)	Difference of Natural Logarithms	Instantaneous Growth Rate Gx	Length Interval (mm)	Difference of Natural Logarithms	Instantaneous Growth Rate Gx
1-2	97-182	0.629	1.888	77-182	0.860	2.581

Age 1+ rainbow trout averaged 173 mm fork length and age 2+ rainbow trout averaged 228 mm fork length (Table 7). Age 1+ and age 2+ brown trout averaged 193 mm and 233 mm, respectively (Table 8).

Table 7. Calculated fork length of rainbow trout from Big Grizzly Creek, 1994.

Age	Number of Fish	Length at Capture	Length at Successive Annulus	
			1	2
1	35	173	100	
2	7	228	95	179
Number of back-calculations			38	4
Weighted means (mm)			99	179
Increments (mm)				80

Table 8. Calculated fork length of brown trout from Big Grizzly Creek, 1994.

Age	Number of Fish	Length at Capture	Length at Successive Annulus	
			1	2
1	4	193	97	
2	3	233	77	179
Number of back-calculations			7	3
Weighted means (mm)			88	182
Increments (mm)				94

Coefficient of Condition

The average coefficient of condition for 93 rainbow trout was 1.1406 and 1.1699 for 48 brown trout. Age 0+ brown trout had slightly higher coefficients of condition than rainbow trout of the same age group (Table 9).

Table 9. Condition of rainbow trout and brown trout in Big Grizzly Creek, 1994.

<u>Age Group</u>	<u>Number of Fish</u>	<u>Coefficient of Condition</u>	<u>95% Confidence Interval</u>
Rainbow trout			
0+	55	1.1866	0.8646-1.5086
1+	31	1.0765	0.8728-1.2803
2+	12	1.1256	1.0157-1.2355
Combined	93	1.1406	0.8510-1.4302
Brown trout			
0+	40	1.1917	1.0055-1.3779
1+	5	1.0718	0.9751-1.2386
2+	3	1.0440	0.9751-1.1129
Combined	48	1.1699	0.9668-1.3731

DISCUSSION

Summer streamflow in Big Grizzly Creek has generally been between 0.6 and 0.3 cms from 1974 to 1993. Higher flows occurred in 1977 and 1979 (Table 10). Haines (1982) reported that optimum flows for rainbow trout was 0.6 cms. Her recommendation was based on an instream flow study that the DWR conducted in 1981. The DWR bases flow releases from Lake Davis on lake water levels in the spring. Lake water levels have been low since 1988 so minimum releases (0.3 cms) have been the rule.

Table 10. Average summer streamflow in Big Grizzly Creek, 1974-1992.

Year	Flow (cms)	Year	Flow (cms)
1974	0.7	1984	0.6
1975	0.4	1985	0.5
1976	0.3	1986	0.6
1977	1.8	1987	0.5
1978	0.3	1988	0.3
1979	2.2	1989	0.3
1980	0.4	1990	0.3
1981	0.3	1991	0.3
1982	0.6	1992	0.3
1983	0.6	1993	0.3

Biomass of rainbow trout has averaged 2.9 g/m² and ranged from 1.9 to 5.6 g/m² since we began sampling in 1976 (Table 11). There is no significant correlation between streamflow and biomass ($r^2 = 0.03$) because rainbow trout biomass was lower in 1986 than we expected from the relative high summer flows that were released that year. Brown trout biomass has averaged 5.0 g/m² and ranged from 0.5 to 15.3 g/m² at station 4. No brown trout has been caught in stations 1 through 3. Brown trout biomass is highly correlated with flow ($r^2 = 0.99$) (Figure 6).

Figure 6 Brown trout biomass vs Flow

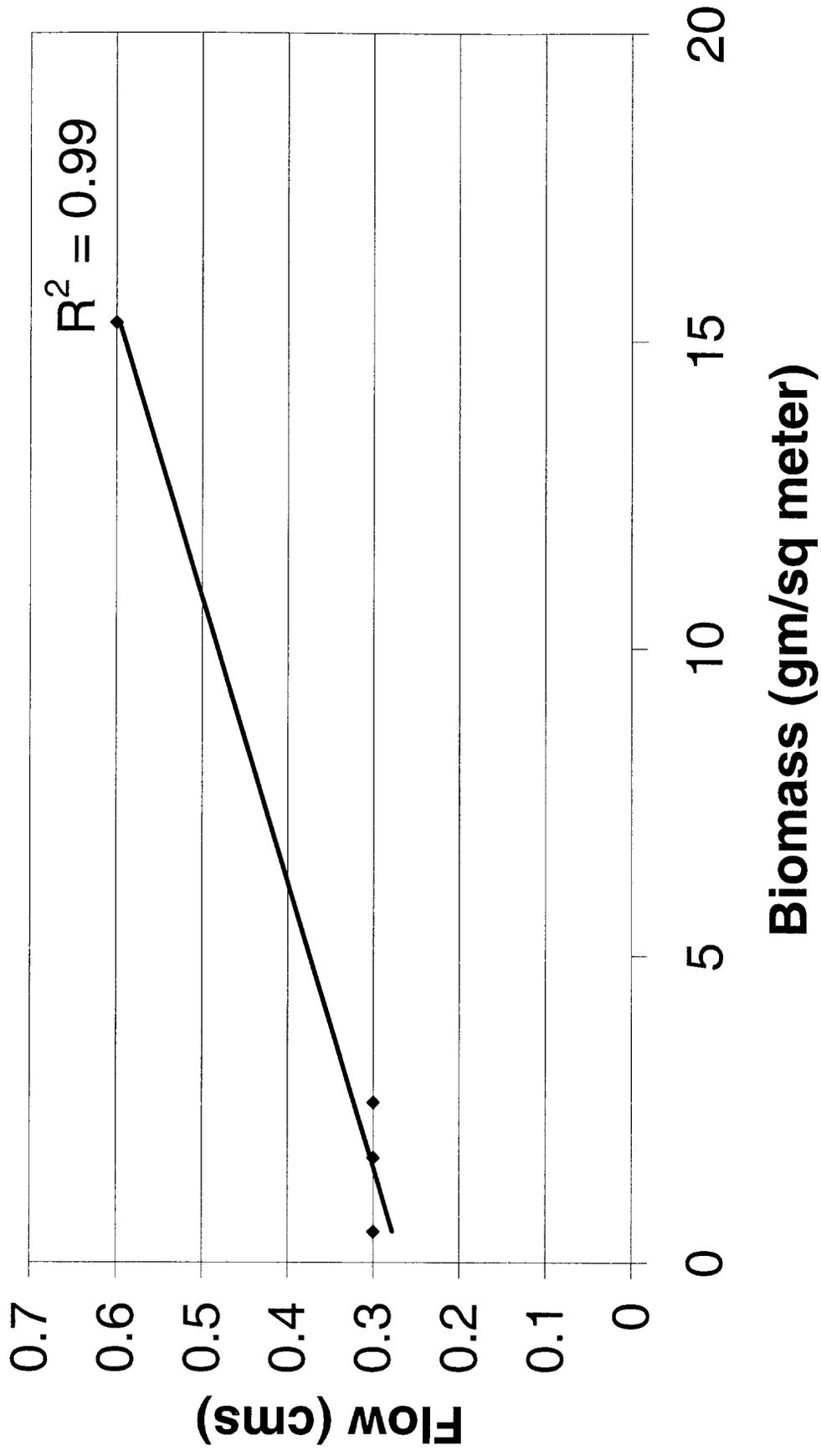


Table 11. Biomass (g/m²) of rainbow and brown trout in Big Grizzly Creek.

Year	Rainbow trout	Brown trout
1976	1.9	-
1981	1.8	0.5
1986	3.2	15.3
1988	5.6	1.7
1993	2.2	2.6

Estimated numbers of catchable-size rainbow trout (≥ 127 mm FL) were the second lowest since we began sampling Big Grizzly Creek in 1981 (Table 12). Catchable-size rainbow trout averaged 0.04 trout/m² and catchable-size brown trout also averaged 0.04 trout/m². Low numbers of both species of trout in 1993 were probably a result of prolonged periods of low flow in Big Grizzly Creek (Table 10). We found a strong correlation between streamflow and numbers of catchable-size rainbow and brown trout in Indian Creek (Brown 1993).

Table 12. Density of catchable-size rainbow and brown trout (trout/m²) in Big Grizzly Creek.

Year	Rainbow trout	Brown trout
1981	0.01	0
1986	0.04	0.08
1988	0.09	0.02
1994	0.02	0.02

LITERATURE CITED

- Brown, C.J. 1976. Standing stocks of fishes in sections of Red Clover Creek, Little Last Chance, Big Grizzly, Last Chance, and Squaw Queen creeks, Plumas County, 1976. Calif. Dept. Fish and Game, 15 p.
- Brown, C.J. 1991a. Standing stocks of fishes in sections of Big Grizzly Creek, Plumas County, 1981. Calif. Dept. Fish and Game, 18 p.
- Brown, C.J. 1991b. Standing stocks of fishes in sections of Big Grizzly Creek, Plumas County, 1988. Calif. Dept. Fish and Game, 18 p.
- Brown, C.J. 1992. Standing stocks of fishes in sections of Big Grizzly Creek, Plumas County, 1991. Calif. Dept. Fish and Game, 21 p.
- Brown, C.J. 1993. A summary of studies of fish populations in Indian Creek, Plumas County, 1977-1990. Calif. Dept. of Fish and Game, 30 p.
- Bumpass, D. K., K. Smith, and C. J. Brown. 1989. Standing stocks of fishes in sections of Big Grizzly and Little Last Chance creeks, Plumas County, 1986. Calif. Dept. Fish and Game, 36 p.
- Carlander, K.D. 1969. Handbook of Freshwater Fishery Biology, Vol. 1. Ames, Iowa: The Iowa State University Press. 752 p.
- DeLury, D. B. 1951. On the planning of experiments for the estimation of fish populations. J. Fish. Res. Bd. Canada. 8:281-307.
- Drummond, R.A. 1966. Techniques in the collection and mounting of trout scales. Progressive Fish Culturist 28(2): 113-116.
- Everhart, H.W., A.W. Eipper, and W.D. Youngs. Principles of Fishery Science. Ithaca, N.Y.:Cornell University Press. 288 p.
- Gerstung, E.R. 1973. Fish populations and yield estimates from California streams. Cal-Neva Wildlife 9-19.
- Haines, S.L. 1982. Upper Feather River flow study. Calif. Dept. Water Resources. 35 p.
- Lagler, K.F. 1956. Freshwater Fishery Biology. Dubuque, Iowa: Wm. C. Brown. 421 p.
- Leslie, P.H., and D.H.S. Davis. 1939. An attempt to determine the absolute number of rats in a given area. J. Animal Ecology. 8:94-113.

- Platts, W.S., W.F. Megahan, and G.W. Minshall. 1983. Methods for evaluating stream, riparian, and biotic conditions. Gen. Tech. Rep. INT-138. Ogden, UT: U.S. Department of Agriculture, Forest Service, Intermountain Forest and Range Experimental Station; 1983. 70p.
- Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Fish. Res. Bd. Canada. Bull. 191.
- Scarnecchia, D.L. 1979. Variation of scale characteristics of coho salmon with sampling location on the body. Progressive Fish Culturist 41(3) 132-135.
- Seber, G. A. F., and E. D. LeCren. 1967. Estimating population parameters from catches large relative to the population. J. Animal Ecology. 36(3):631-643.
- Steel, R.G.D. and J.H. Torrie. 1960. Principles and Procedures of Statistics. McGraw-Hill Book Company, Inc. 481 p.

APPENDIX 1

PERMANENT FISH POPULATION STATIONS FOR BIG GRIZZLY CREEK, PLUMAS COUNTY SEPTEMBER, 1994

Station 1 (Stream Gage Station) - Station 1 is located 2.5 stream km below Grizzly Valley Dam and just downstream from an abandoned USGS stream gage at an elevation of 1622 m MSL. The station is located 21 m downstream from the concrete weir of the stream gage (UTM 170 167). The stream within the station is a steep rapid area (67%) with several split channels and small pocket pools that ends in a long, shallow pool (33%). It is 44.8 m long and has a surface area of 322.6 m² at 0.56 cms. Substrate is 75% boulders, 15% rubble, and 10% sand.

Station 2 (IFN Station) - Station 2 is 3.2 stream km below Grizzly Valley Dam. The site located at UTM 176 156 at an elevation of 1610 m MSL. The upper end of the station is a steep rapid (55%) followed by two deep pools (45%) separated by short rapids. The substrate is mostly rubble (60%), boulder (20%), gravel (10%), with areas of sand (10%) in the pools. The station is 83.6 m long with a surface area of 342.8 m² at 0.56 cms.

Station 3 (3-Mile Station) - Station 3 is located 4.8 km downstream from Grizzly Valley Dam at an elevation of 1549 m MSL at UTM 189 141. The station begins in a steep rapid followed by more gradual rapids (75%) with pocket pools and two larger pools (25%) near the lower end. Substrate is boulder (65%), rubble (20%), sand (10%), and gravel (5%). The station is 51.5 m long and has a surface area of 283.3 m² at 0.56 cms.

Station 4 (6-Mile Station) - Station 4 is located 9.7 km below Grizzly Valley Dam and 0.2 km above the confluence with the Middle Fork Feather River at an elevation of 1488 m MSL. It is located at UTM 205 106. The station begins in a rapid just above a large 0.7 m deep pool (33%) followed by several riffle areas (67%) and shallow pools with undercut banks and overhanging grass clumps. Substrate is rubble (10%), gravel (75%), bedrock (10%), and mud (5%). The station is 99.7 m long with a surface area of 468.6 m² at 0.56 cms.

APPENDIX 2

LENGTH AND NUMBER OF RAINBOW TROUT
CAUGHT IN BIG GRIZZLY CREEK, 1994

Fork Length (mm)	Frequency of Occurrence	Fork Length (mm)	Frequency of Occurrence
64	1	94	1
65	1	95	2
66	1	97	1
67	1	100	2
69	1	101	1
70	4	103	1
71	3	104	2
72	1	107	1
73	1	111	1
75	1	114	1
76	2	129	1
77	1	130	1
78	2	132	1
79	2	135	1
80	1	145	1
81	1	148	1
82	1	151	1
83	1	153	1
84	4	156	1
85	1	163	1
86	2	166	2
87	1	170	1
90	2	171	1
91	1	173	1
93	1	174	1

APPENDIX 2 (Continued)

Fork Length (mm)	Frequency of Occurrence
176	1
177	2
180	1
184	1
185	1
186	2
190	1
191	1
193	3
194	1
196	1
197	1
198	3
206	1
212	1
213	1
232	1
233	1
244	1
254	1

APPENDIX 3

LENGTH AND NUMBER OF BROWN TROUT
CAUGHT IN BIG GRIZZLY CREEK, 1994

Fork Length (mm)	Frequency of Occurrence	Fork Length (mm)	Frequency of Occurrence
69	1	96	3
71	1	100	1
76	1	102	1
77	1	103	1
78	1	104	1
80	3	109	2
81	1	110	1
82	2	165	1
83	2	193	1
84	2	199	1
85	2	200	1
86	2	207	1
88	2	225	1
89	1	234	1
90	3	240	1
93	2		
94	2		
95	1		

APPENDIX 4

LENGTH AND WEIGHT OF RAINBOW TROUT
CAUGHT IN BIG GRIZZLY CREEK, 1994

Fork Length (mm)	Weight (g)	Fork Length (mm)	Weight (g)
64	3	94	9
65	4	95	9,10
66	4	97	12
67	3	100	11,11
69	3	101	13
70	4,4,4,5	103	11
71	4,4,5	104	12,13
72	4	107	15
73	6	111	15
75	5	114	17
76	5,7	129	23
77	4	130	20
78	5,5	132	34
79	6,7	135	25
80	8	145	34
81	7	148	31
82	7	151	35
83	7	153	37
84	5,7,7,7	156	45
85	8	163	45
86	6,7	166	47,55
87	8	170	55
90	8,9	171	54
91	10	173	55
93	9	174	60

APPENDIX 4 (Continued)

Fork Length (mm)	Weight (g)
176	60
177	53,61
180	60
184	69
185	70
186	64,69
190	68
191	76
193	68,77,85
194	65
196	85
197	80
198	81,90,94
206	102
212	99
213	110
232	130
233	150
244	166
254	191

APPENDIX 5

LENGTH AND WEIGHT OF BROWN TROUT
CAUGHT IN BIG GRIZZLY CREEK, 1994.

Fork Length (mm)	Displacement (ml)	Fork Length (mm)	Displacement (ml)
69	4	96	10,10,11
71	5	100	12
76	5	102	13
77	6	103	12
78	6	104	12
80	6,6,7	109	14,15
81	6	110	16
82	7,8	165	52
83	7,7	193	74
84	7,7	199	80
85	7,8	200	95
86	8,8	207	86
88	8,8	225	115
89	8	234	132
90	7,8,8	240	151
93	9,9		
94	9,11		
95	10		