State of California
The Resources Agency
DEPARTMENT OF FISH AND GAME

STANDING STOCKS OF FISHES IN SECTIONS OF BIG GRIZZLY CREEK PLUMAS COUNTY, 2002

by

Charles J. Brown
Central Valley Bay-Delta Branch

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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 current instream values, and to identify actions such as habitat manipulation that could enhance these streams. The Northern District of the DWR selected Big Grizzly Creek below Lake Davis (Figure 1) as one of the streams to study under this program.

Previous sampling 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, 1991, 1994 through 2001 to estimate standing stocks of brown trout (*Salmo trutta*) and rainbow trout in selected stations (Bumpass et al. 1989, Brown 1991a, Brown 1991b, Brown 1992, Brown 1995, Brown 1996, Brown 1997, Brown 1998, Brown 1999, Brown 2000, Brown 2001, and Brown 2002).

The purpose of this study is to evaluate the effects of the operation of Lake Davis on populations of trout in Big Grizzly Creek through the periodic sampling of fish at established stations in that creek. These data may also be used to measure the recovery of the trout the DFG planted in Big Grizzly Creek following the rotenone treatment that was conducted in October 1998 to kill northern pike (*Esox lucius*) in Lake Davis.

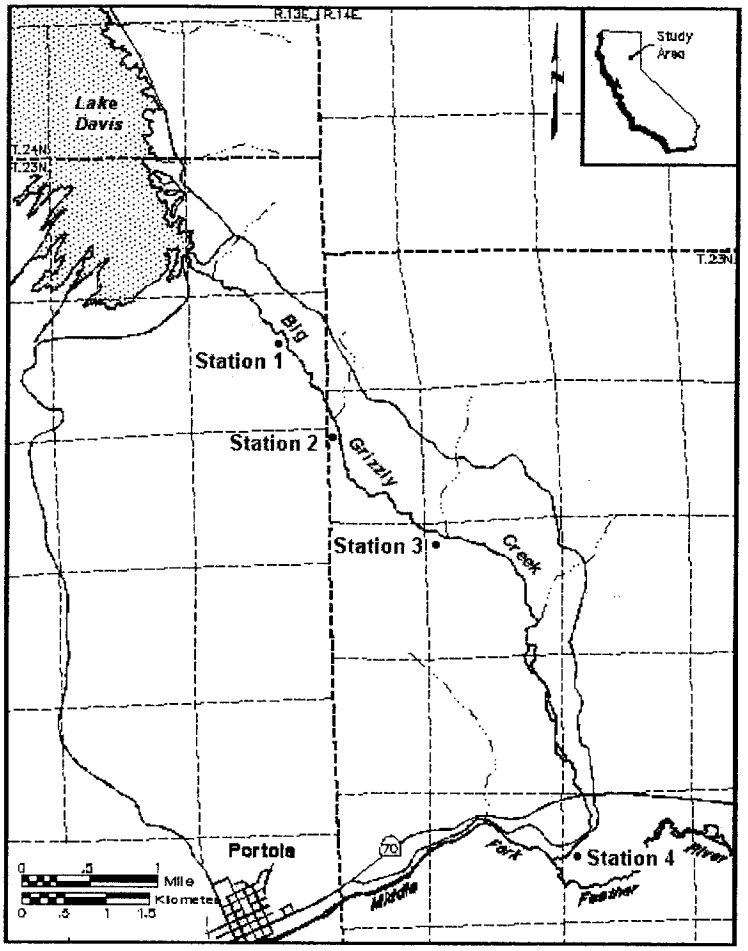

Figure 1. Map of sampling stations in Big Grizzly Creek Plumas County, 2002.

METHODS

Physical Measurements

Standing stocks of fishes were estimated at four stations in Big Grizzly Creek in October 2001(Figure 1). These stations were intentionally selected to be near stations sampled in previous DFG studies (Gerstung 1973), and to represent available habitat in Big Grizzly Creek. Markers were placed in trees along the stream to identify station boundaries. Stations ranged in length from 46.8 to 99.6 m (Appendix 1). The length and width of each station was measured with metric tape measures.

Water quality in Big Grizzly Creek was measured at stations 1 and 4. Water temperature was measured with a hand-held thermometer. Conductivity was measured with an Oakton CON 400 series conductivity meter and turbidity was measured with a Orbeco-Hellige model 956 portable turbidimeter. Dissolved oxygen was measured with an Oakton DO 300 series meter and pH was measured with an Oakton model 300 pH meters.

Biological Measurements

Fish were captured with a Smith Root model 12b battery-powered backpack electroshocker in stream sections blocked by seines as described by Platts et al. (1983) (Figure 2). 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 (Figure 3). Fork length (FL) of each fish caught was measured to the nearest millimeter. See Appendices 2 and 3 for measurements of brown and rainbow trout caught.

Growth rates and condition factors were calculated to provide baseline information that will be used to measure the effects of changes in habitat on trout populations (Ricker 1958).

Standing crops of brown trout and rainbow trout were calculated for individual stations where each species was caught. Trout have not been planted in Big Grizzly Creek since 1999 (Table 1). The distribution of all fish caught is listed according to station.

Table 1. Records of trout planted in Big Grizzly Creek by the DFG in 1999.

Species of Fishes	Date	Average Length of Trout (mm)	Number of Trout
Rainbow trout	14-Jul	230	1020
Rainbow trout	15-Jul	74	4500
Rainbow trout	15-Jul	30	5496
Rainbow trout	6-Aug	55	1000
Rainbow trout	4-Oct	180	25
Brown trout	15-Jul	54	1000
Brown trout	3-Aug	280	1001
Brown trout	4-Oct	180	25

RESULTS

Water Quality

All parameters of water quality were taken near 1200 hours on September 24-26, 2002. Temperature in Big Grizzly Creek during those dates ranged from 11.4°C to 15°C. Conductivity and turbidity increased downstream from the dam. PH averaged 8 and dissolved oxygen averaged 9.4 at the two stations. These values are well within safe limits for trout rearing (Piper et. al. 1982).

Figure 2. Electrofishing in Big Grizzly Creek, Plumas County.

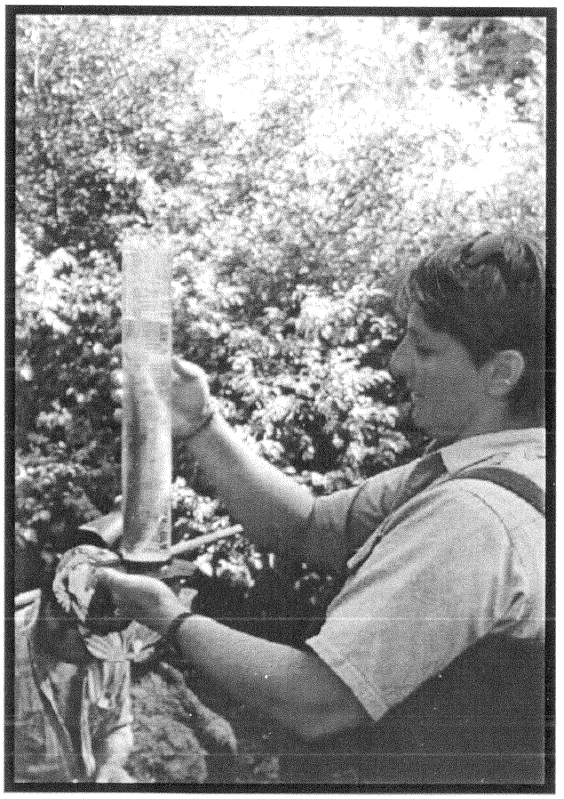

Figure 3. Measuring weights of trout by displacement.

Table 2. Parameters of water quality collected in Big Grizzly Creek, Plumas County, 2002.

	Station 1	Station 4
Temperature	14.5° C	11.2° C
Conductivity	111.5 us	126.6 us
Turbidity	6.7 NTU	11.1 NTU
pH	14.5	11.2
Dissolved Oxygen	14.8 mg/l	11.3 mg/l

Distribution

Rainbow trout and brown trout were caught at all stations. Sacramento suckers (*Catostomus occidentalis*) were caught at station 3 and station 4, and a black bullhead (*Ameuris melas*) and a green sunfish (*Lepomis cyanellus*) were caught at station 4 (Table 3).

Table 3. Distribution of fishes in sections of Big Grizzly Creek, Plumas County, 2002.

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

Standing Crop

We found brown trout and rainbow trout at all four stations. Biomass of brown trout was 4.4 g/m^2 (Table 4). Catchable brown trout (trout greater than or equal to 127 mm FL) biomass averaged 3.3 g/m^2. Biomass of rainbow trout averaged 2.2 g/m^2 (Table 4). Catchable rainbow trout biomass averaged 1.4 g/m^2. Biomass was not estimated for green sunfish, Sacramento suckers, or black bullhead.

Table 4. Estimate of brown trout standing crop in Big Grizzly Creek, Plumas County, 2002.

Distance below Grizzly Valley Dam (km)	Population Estimate	95 Percent Confidence Estimate	Biomass (g/m^2)	Estimate of Catchable Trout	Biomass of Catchable Trout (g/m^2)
2.5	45	38-59	5	15	3.2
3.2	38	35-45	8.6	14	6.4
4.8	8	9-11	2.9	9	2.8
9.7	46	43-53	3.2	10	2.4

Table 5. Estimate of rainbow trout standing crop in Big Grizzly Creek, Plumas County, 2002.

Distance below Grizzly Valley Dam (km)	Population Estimate	95 Percent Confidence Estimate	Biomass (g/m^2)	Estimate of Catchable Trout	Biomass of Catchable Trout (g/m^2)
2.5	49	48-52	2.9	10	1.9
3.2	26	26-27	4.4	5	2.6
4.8	21	21-23	2.1	11	1.5
9.7	8	8-10	0.9	3	0.6

Length and Weight

Age group 0+ rainbow trout represented 68 percent of the 103 rainbow trout caught. Age 1+ comprised 29 percent, and age 2+ made up 3 percent (Figure 4). Age group 0+ brown trout made up 43 percent of the 119 brown trout caught. Age 1+ comprised 49 percent, age 2+ comprised 8 percent, and age 3+ made up 1 percent (Figure 5).

The relationship between fork length and weight (W) of age 0+ and 1+ rainbow trout for Big Grizzly Creek is:

$$\text{Log}_{10}W = -4.6 + 2.8\ \text{Log}_{10}FL$$
$$r^2 = 0.98$$
N = 103 (Figure 6 and Appendix 2)

The same relationship for brown trout is:

$$\text{Log}_{10}W = -5.0 + 3.0\ \text{Log}_{10}FL$$
$$r^2 = 0.99$$
N = 119 (Figure 7 and Appendix 3)

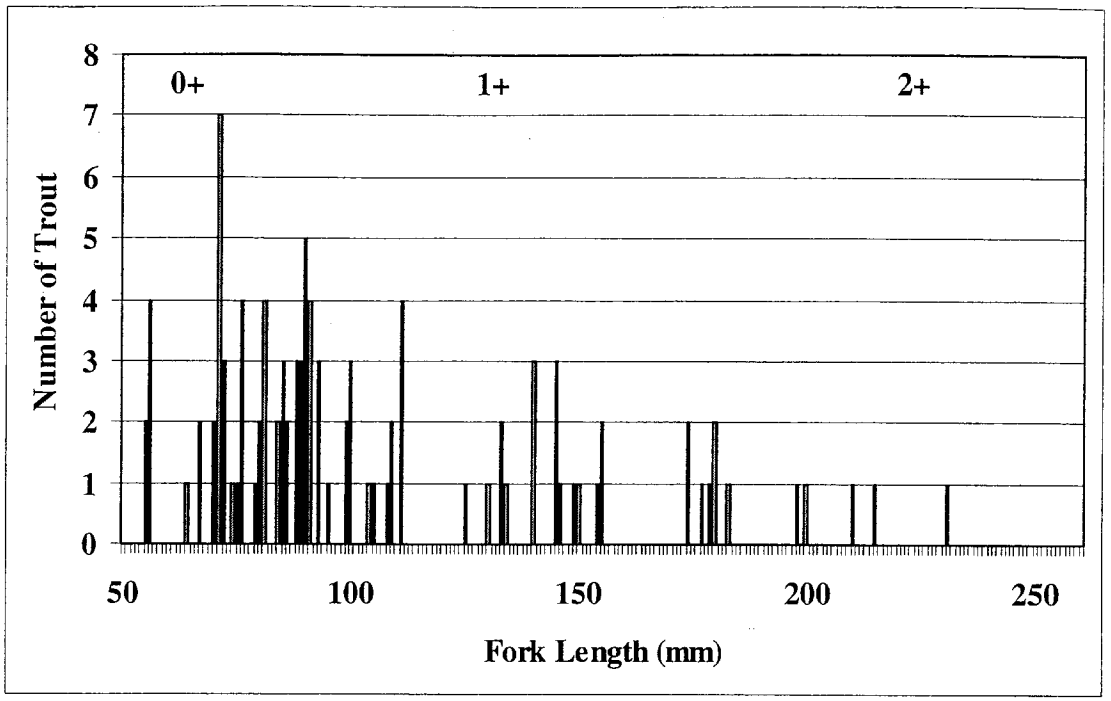

Figure 4. Length, observed frequency, and age of rainbow trout caught in Big Grizzly Creek, Plumas County, 2002.

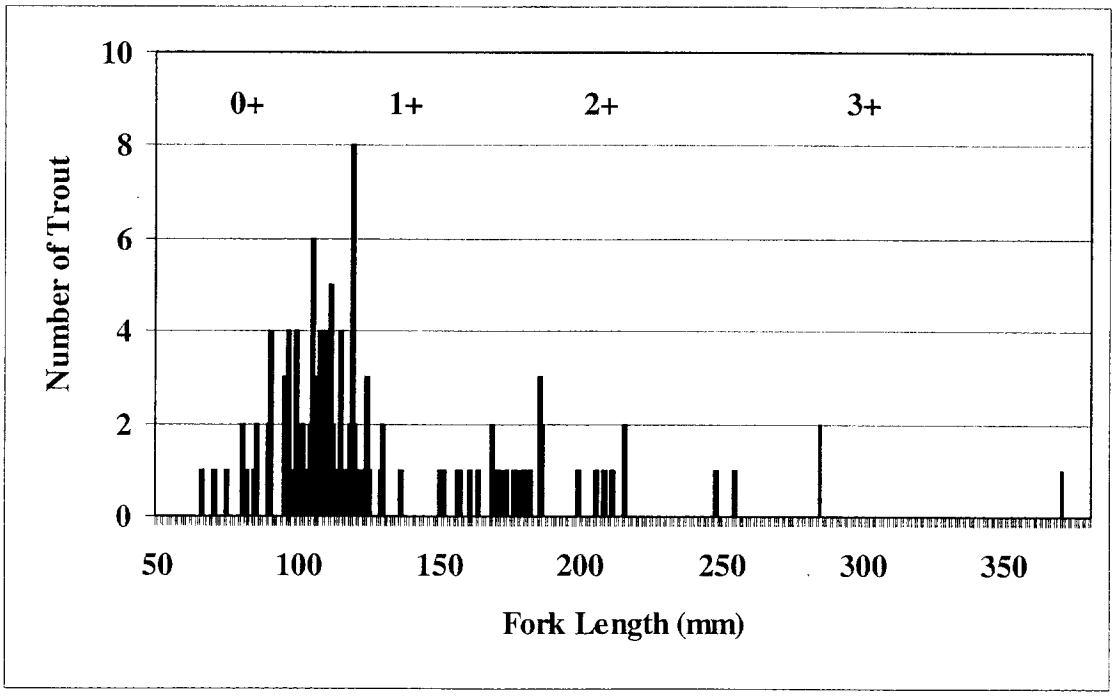

Figure 5. Length, observed frequency, and age of brown trout caught in Big Grizzly Creek, Plumas County, 2002.

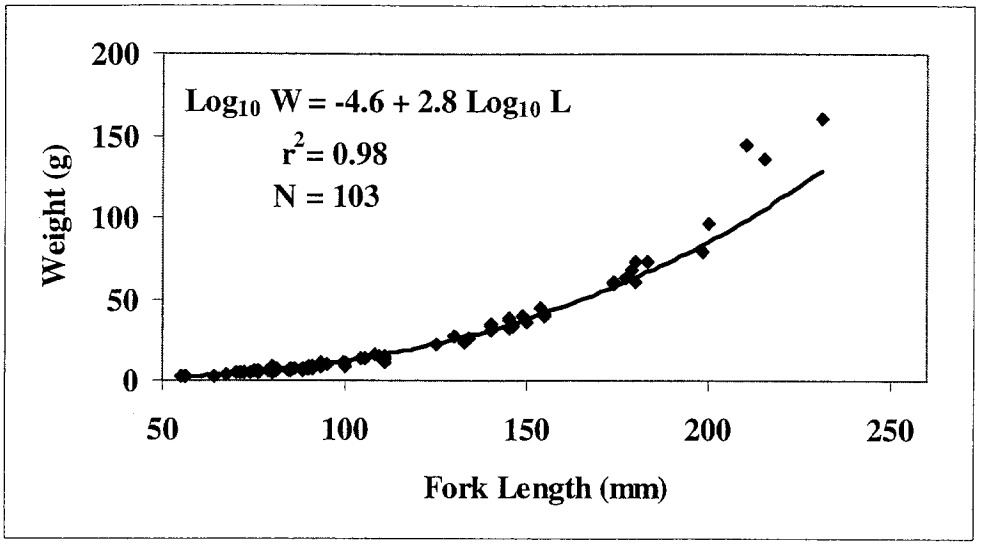

Figure 6. The relationship between length and weight of rainbow trout caught in sections of Big Grizzly Creek, Plumas County, 2002.

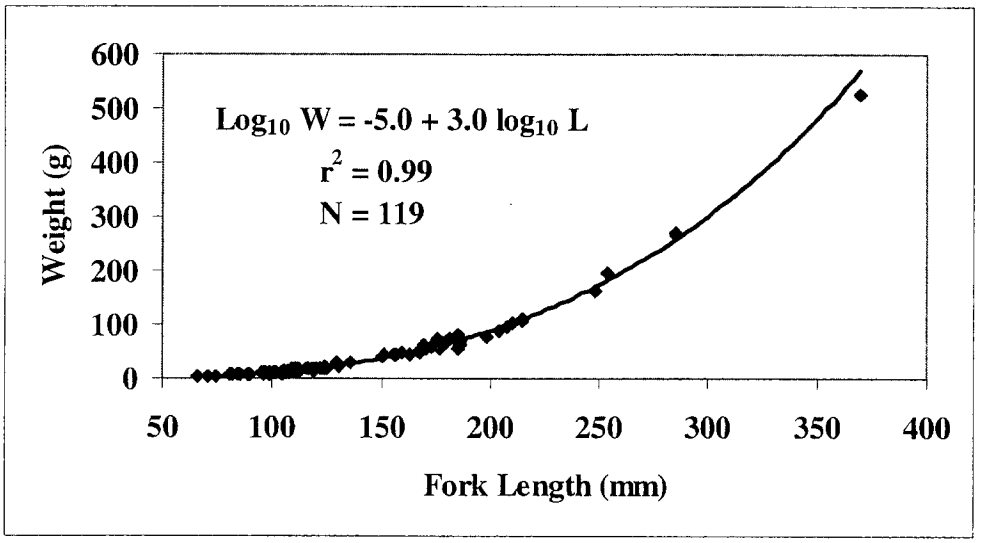

Figure 7. The relationship between length and weight of brown trout caught in sections of Big Grizzly Creek, Plumas County, 2002.

Age and Growth

The formula FL = 1.0 + 0.2 S describes the relationship between the fork length and enlarged scale radius (S) of 25 rainbow trout caught in Big Grizzly Creek. The coefficient of correlation (r^2) is 0.79. The formula was FL = -0.6 + 0.3 S for 63 brown trout, while the value for r^2 is 0.80.

The population instantaneous growth rate was greater than the mean individual instantaneous growth rate for age 1+ brown trout (Table 6). Population growth was also greater than mean individual growth in rainbow trout (Table 7).

Table 6. Growth rates for brown trout caught in Big Grizzly Creek, Plumas County, 2002.

	Population Growth			Mean Individual Growth		
Age Interval	Length Interval (mm)	Difference in Natural Logarithms	Instantaneous Growth Rate G_x	Length Interval (mm)	Difference in Natural Logarithms	Instantaneous Growth Rate G_x
1-2	99-195	0.678	2.034	100-195	0.668	2.004
2-3	195-274	0.34	1.02	191-274	0.361	1.083

Table 7. Growth rates for rainbow trout caught in Big Grizzly Creek, Plumas County, 2002.

	Population Growth			Mean Individual Growth		
Age Interval	Length Interval (mm)	Difference in Natural Logarithms	Instantaneous Growth Rate G_x	Length Interval (mm)	Difference in Natural Logarithms	Instantaneous Growth Rate G_x
1-2	92-168	0.602	1.806	99-168	0.529	1.587

Age 1+ brown trout averaged 161 mm in fork length; 2+ fish averaged 238 mm, and one age 3+ fish was 287 mm (Table 8). Age 1+ and 2+ rainbow trout averaged 134 mm and 218 mm, respectively (Table 9).

Table 8. Calculated fork length of brown trout from Big Grizzly Creek, Plumas County, 2002.

Age	Number of Fish	Length at Capture (mm)	Calculated Lengths at Successive Annuli		
			1	2	3
1	59	149	99		
2	3	262	112	219	
3	1	370	100	226	274
Number of back-calculations			63	4	1
Weighted means (mm)			100	221	324
Increments (mm)			97	121	103

Table 9. Calculated fork length of rainbow trout from Big Grizzly Creek, Plumas County, 2002.

Age	Number of Fish	Length at Capture (mm)	Calculated Lengths at Successive Annuli	
			1	2
1	30	156	92	
2	2	221	99	168
Number of back-calculations			32	7
Weighted means (mm)			92	168
Increments (mm)			92	76

Coefficient of Condition

The average coefficient of condition for 103 rainbow trout was 1.2128 and it was 1.0989 for 119 brown trout. Age 0+ rainbow trout had slightly higher coefficients of condition than brown trout of the same age group. (Table 10).

Table 10. Condition of rainbow trout and brown trout in Big Grizzly Creek, Plumas County, 2002.

Age	Number of Fish	Coefficient of Condition	95% Confidence Interval
		Brown Trout	
0+	49	1.0954	0.8460-1.3448
1+	60	1.1001	0.9094-1.2908
2+	9	1.1171	1.0178-1.2164
3+	1	1.0365	
Combined	119	1.0989	0.8876-1.3102
		Rainbow Trout	
0+	70	1.2484	0.8298-1.6670
1+	30	1.1103	0.9056-1.3150
2+	3	1.4071	1.1483-1.6660
Combined	103	1.2128	0.8242-1.6015

Streamflow

Summer streamflow in Big Grizzly Creek has generally been between 0.6 and 0.3 cms from 1974 to 2002. Higher flows occurred in 1977 and 1979 (Table 6). Haines (1982) reported that optimum flow 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 were low from 1988 through 1994 so minimum releases (0.3 cms) were the rule during this period. Releases were higher from 1995 through 1999, but they dropped again in 2000 and 2001.

Table 11. Average summer streamflow in Big Grizzly Creek, 1974-2002.

	Flow (cms)	Year	Flow (cms)
1974	0.7	1989	0.3
1975	0.4	1990	0.3
1976	0.3	1991	0.3
1977	1.8	1992	0.3
1978	0.3	1993	0.3
1979	2.2	1994	0.3
1980	0.4	1995	0.6
1981	0.3	1996	0.6
1982	0.6	1996	0.6
1983	0.6	1997	0.6
1984	0.6	1998	0.6
1985	0.5	1999	0.6
1986	0.6	2000	0.3
1987	0.5	2001	0.3
1988	0.3	2002	0.3

Biomass of rainbow trout has averaged 2.7 g\m^2 and ranged from 0 to 7.3 g\m^2 since sampling began in 1976 (Table 12). No significant correlation between streamflow and biomass ($p>0.05$) has been found. Despite relative high summer flows in 1986 and 1995, rainbow trout biomass was lower than we expected. Brown trout biomass has averaged 2.0 g/m^2 and ranged from 0 to 6.0 g/m^2. Brown trout biomass is also not correlated with flow ($p>0.05$)

Table 12. Biomass (g/m^2) of rainbow and brown trout in Big Grizzly Creek.

Year	Rainbow trout	Brown trout
1976	1.9	-
1981	1.8	0.1
1986	3.2	3.8
1988	5.6	0.4
1994	2.2	0.7
1995	1	0.5
1996	4.5	0.5
1997	7.3	2.2
1998	1.6	3.1
1999	0	6
2000	2	2.3
2001	2	2.3
2002	2.2	4.2

DISCUSSION

Our sampling has not revealed the presence of northern pike in Big Grizzly Creek. However, we sample in riffles and shallow pools because our electrofisher is not effective in deeper pools. Therefore, because pike are often found in deeper pools we are unlikely to capture them if they are present. If sampling for pike was our primary objective, we would gill net pools in addition to electrofishing.

We have not established a significant relationship between flow and trout standing crop or biomass. We think it is likely, however, that there is a significant relationship between streamflow and trout populations in Big Grizzly Creek. More data points are needed. Continued sampling will allow us to examine this possibility.

Wide confidence intervals for trout population estimates have been a problem at station 4. Station 4 has a wide pool at the upstream end which allows some of the trout to swim around the sampling team on each pass. This station also harbors a large proportion of young-of-the–year trout. Small fish are difficult to capture with an electrofisher because they present less surface to the electrical current.

The year 2002 was the first year since Big Grizzly Creek was poisoned (due to the Lake Davis treatment) that all ages of trout in the stream were hatched in the gravels of the creek. All trout reflect the stream conditions of the years of their growth.

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APPENDIX 1

PERMANENT FISH POPULATION STATIONS FOR
BIG GRIZZLY CREEK, PLUMAS COUNTY
SEPTEMBER, 2002

Station 1 (Stream Gage Station) - Station 1 is located 1.8 stream km below Grizzly Valley Dam and just downstream from an abandoned USGS stream gage at an elevation of 1622 m above mean sea level (MSL). The station begins at a concrete weir near a stream gage (UTM 170 167). The stream within the station is a riffle (67%) with several split channels and small pocket pools that ends in a long, shallow pool (33%). It is 46.8 m long and has a surface area of 270.7 m^2 at 0.3 cms. Substrate is 75% boulders, 15% rubble, and 10% sand.

Station 2 (IFN Station) - Station 2 is 3.1 stream km below Grizzly Valley Dam. The site is 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 51.8 m long with a surface area of 180 m^2 at 0.3 cms.

Station 3 (3-Mile Station) - Station 3 is located 5.2 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 47.5 m long and has a surface area of 236.2 m^2 at 0.3 cms.

Station 4 (6-Mile Station) - Station 4 is located 10.4 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 99.6 m long with a surface area of 442.6 m^2 at 0.3 cms.

APPENDIX 2

LENGTH AND WEIGHT OF RAINBOW TROUT
CAUGHT IN BIG GRIZZLY CREEK, 2002

Fork Length (mm)	Weight (g)	Fork Length (mm)	Weight (g)	Fork Length (mm)	Weight (g)
55	3	84	6	109	15
55	2	84	6	109	15
56	3	85	6	111	13
56	3	85	6	111	13
56	3	85	8	111	11
56	3	86	7	111	15
64	3	86	8	125	22
67	4	88	8	130	27
67	4	88	8	133	23
70	5	88	6	133	24
70	5	89	7	134	26
71	5	89	7	140	34
71	5	89	8	140	31
71	5	90	8	140	33
71	5	90	8	145	32
71	5	90	7	145	38
71	5	90	7	145	37
71	5	90	9	146	33
72	5	91	8	149	39
72	5	91	9	150	36
72	5	91	8	154	44
74	5	91	8	155	41
75	6	93	11	155	40
76	5	93	11	174	61
76	6	93	9	174	59
76	5	95	10	177	63
76	6	99	11	179	68
79	6	99	11	180	61
80	9	100	9	180	73
80	5	100	11	183	73
81	8	100	11	198	79
81	6	104	14	200	96
81	8	105	14	210	144
81	6	108	16	215	136
				231	160

APPENDIX 3

LENGTH AND WEIGHT OF BROWN TROUT CAUGHT IN BIG GRIZZLY CREEK, 2002.

Fork Length (mm)	Weight (g)	Fork Length (mm)	Weight (g)	Fork Length (mm)	Weight (g)	Fork Length (mm)	Weight (g)
66	3	104	12	115	18	151	44
70	5	105	10	115	17	156	43
74	4	105	13	115	18	157	45
80	6	105	14	115	18	160	49
80	6	105	13	116	17	163	44
81	6	105	12	118	16	168	51
84	6	105	13	118	18	168	48
85	7	106	12	119	20	170	62
85	6	107	16	119	17	171	55
89	7	107	16	119	17	173	60
89	8	107	13	119	17	176	73
90	7	108	14	119	17	177	57
90	8	108	12	119	17	179	65
90	8	108	14	119	17	180	65
90	9	108	13	119	19	181	69
95	10	109	14	119	17	182	75
95	10	109	14	119	15	185	73
95	10	109	15	120	19	185	80
96	8	109	17	120	18	185	57
96	11	109	15	122	19	186	63
96	11	110	15	123	19	186	69
96	10	111	14	123	19	198	79
97	10	111	15	124	24	204	90
99	7	111	15	124	23	207	96
99	11	111	14	124	19	210	105
99	10	111	14	125	20	215	107
99	10	111	17	129	28	215	111
101	11	112	15	130	24	248	162
101	10	112	15	130	25	254	197
102	12	112	17	136	28	285	265
104	9	113	15	150	39	285	272
						370	525