FISHERIES OF MOUNTAIN LAKES IN THE CRAZY MOUNTAINS: ANNUAL REPORT FOR 1990

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and

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INTRODUCTION

The high mountain lakes of the Crazy Mountains provide an excellent opportunity for quality fishing in a primitive mountain setting. Marcuson did extensive surveys of the lakes in 1973 and 1980 which summarized access, morphology, zooplankton, fisheries, fish planting records, and existing and recommended management (Marcuson 1981). Fisheries in these lakes were last surveyed in 1983 (Fredenberg and Swedberg 1984). This report documents fisheries surveys completed in 1990 to assess the existing trout populations and determine if management strategies and fish planting programs for each lake were providing the desired results.

STUDY AREA DESCRIPTION

Marcuson (1981) describes the study area and tabulated physical features of each lake (Appendix A). The Crazy Mountains are located in south central Montana approximately 15 miles northeast of Big Timber, Montana. A total of 50 lakes were identified by Marcuson within the Crazy Mountains (Figure 1). In 1973 he found 15 of these lakes supported trout populations. From 1973 to 1980 six additional lakes were planted with trout. Stocking histories of all Crazy Mountain lakes surveyed during 1990 are provided in Table 1. We surveyed Blue, Campfire, Cascade, Cave, Cottonwood, Druckmiller, Granite, Moose, North Fork, Pear, Rock, Smeller, Sunlight, Swamp Creek, Thunder, Lower and Upper Twin lakes during 1990. The lakes Marcuson identified as having fish which were not surveyed in 1990 included Hidden (or Fish), Crazy, Lower North Fork, Lower Sunlight, and Forest lakes.

METHODS

A crew either flew into each lake with a helicopter equipped with pontoons or packed into lakes (lakes within the Big Timber Creek drainage) with an inflatable raft. A single monofilament nylon mountain gill net was set for one night in each lake. Fish captured in gill nets were weighed and measured. Scale samples were taken from most captured fish, pressed into acetate, and later ages were interpreted from scale samples using a microfiche reader at 42X magnification. Stomach samples from fish captured in Blue, Cottonwood, Druckmiller, Granite, Pear, Smeller, Swamp Creek, Thunder, and Lower and Upper Twin lakes were cursorily examined to determine relative food habits at the time of sampling. Lakes within the Big Timber Creek drainage were angled to supplement gill net data. Big Timber Creek was also angled and the results of that angling are reported below.

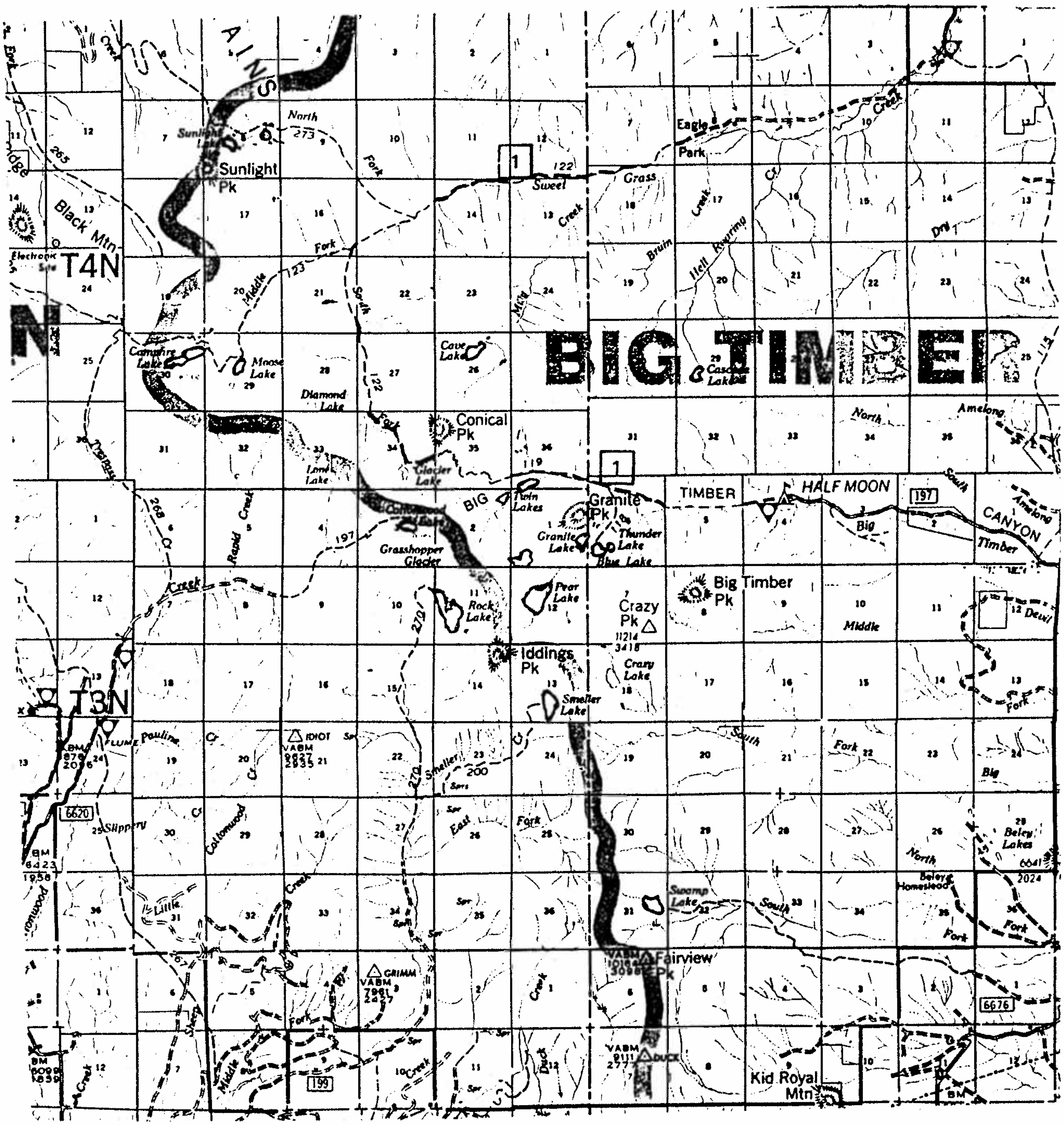

Figure 1. Map of the Crazy Mountains showing locations of mountain lakes sampled in 1990. Map taken from Marcuson (1981).

Table 1. Fish plants made by the state of Montana into lakes within the Crazy Mountains surveyed during 1990. Species codes are: CT = undesignated cutthroat trout; EBT = Eastern brook trout; GR = Arctic grayling; GT = golden trout; RB = rainbow trout (letters in parentheses denote strain with A = Arlee; D = DeSmet; I = Eagle Lake; L = Lewistown [Erwin]; P = Triploid); and YCT = Yellowstone cutthroat trout (McBride strain). Size is in inches with zeros denoting fry.

Lake	Date planted	Species	Size	Number	Number/acre
Blue Lake	No record of any plants				
Campfire Lake	09/12/32	CT	0	45,000	1,270
	08/12/39	CT	0	18,800	530
	08/07/80	YCT	2	4,000	113
	08/21/84	YCT	2	5,310	150
	08/02/88	YCT	2	5,303	149
Cascade Lake	07/13/46	EBT	2	764	112
	08/27/74	YCT	1	960	140
	08/24/78	YCT	2	1,000	147
	07/28/82	YCT	2	1,012	149
Cave Lake	09/10/80	GT	1	1,300	84
	09/15/84	GT	1	5,000	323
Cottonwood Lake	08/19/63	CT	3	450	49
	07/31/69	YCT	3	1,045	114
	07/29/72	YCT	3	1,536	167
	08/11/76	YCT	2	1,064	116
	07/17/79	YCT	2	1,010	110
	08/21/84	YCT	2	1,000	109
	08/02/88	YCT	2	994	108
Druckmiller Lake	09/13/33	EBT	2	1,500	62
	09/03/35	RB	0	6,000	248
	09/10/36	RB	2	10,000	413
	09/02/37	RB	1	5,000	206
	09/28/76	(L)RB	2	2,094	87
	08/24/78	(A)RB	5	2,025	84
	08/21/84	(P)RB	4	4,004	165
	08/10/87	(I)RB	4	4,000	165
Granite Lake	No record of any plants				

Table 1. Continued.

Lake	Date planted	Species	Size	Number	Number/acre
Moose Lake	10/10/31	CT	2	7,040	537
	08/09/41	YCT	0	3,492	266
North Fork Lake	08/18/38	YCT	0	22,350	4,967
	07/17/49	RB	2	10,000	2,222
Pear Lake	09/03/35	RB	0	6,000	150
	09/10/36	RB	2	10,000	251
	09/02/37	RB	1	5,000	126
	09/28/76	(L)RB	2	4,188	105
	08/24/78	(A)RB	2	2,025	51
	08/18/84	(D)RB	3	4,032	101
Rock Lake	09/22/35	RB	2	8,000	160
	09/11/47	CT	0	11,700	235
	08/19/63	YCT	2	2,500	50
	08/24/78	YCT	2	1,500	30
	08/06/81	YCT	2	1,511	30
	08/02/83	YCT	2	2,538	51
	08/08/89	YCT	2	2,500	50
Smeller Lake	09/22/35	RB	2	8,000	364
	08/30/40	YCT	0	10,080	458
	08/19/63	CT	3	1,100	50
	07/31/69	YCT	3	1,045	48
	07/29/72	YCT	3	1,536	70
	08/11/76	YCT	2	1,064	48
	07/17/79	YCT	2	1,010	46
	08/21/84	YCT	2	1,100	50
	08/02/88	YCT	2	1,104	50
Sunlight Lake	06/19/37	EBT	2	11,000	1,375
	08/20/39	CT	1	25,200	3,150
	08/01/41	RB	0	22,400	2,800
	08/27/74	YCT	1	1,440	180
	08/24/78	YCT	2	1,500	188
	07/28/82	YCT	2	1,505	188
	07/29/86	YCT	1	1,050	131
Swamp Creek Lake	08/31/54	EBT	2	9,000	405
	07/27/59	EBT	3	9,900	446
Thunder Lake	No record of any plants				
Twin Lakes	07/25/36	EBT	0	5,004	288
	07/17/38	RB	0	4,200	241
	08/28/44	RB	5	7,776	447
	08/05/85	GR	2	300	17

RESULTS

Blue Lake

Blue Lake was sampled via angling on August 20 and by a single mountain gill net set the night of August 20 and retrieved the morning of August 21. A total of ten rainbow trout were captured via angling. These ten trout averaged 8.3 inches (range: 5.0 to 11.5). A total of 14 rainbow trout were captured in the gill net (Table 2). These 14 trout averaged 9.9 inches. A cursory examination of the stomach contents of a few of the captured fish found these fish were eating immature and mature forms of aquatic macroinvertebrates and a few terrestrial insects. The gill net captured larger fish than anglers (Figure 2).

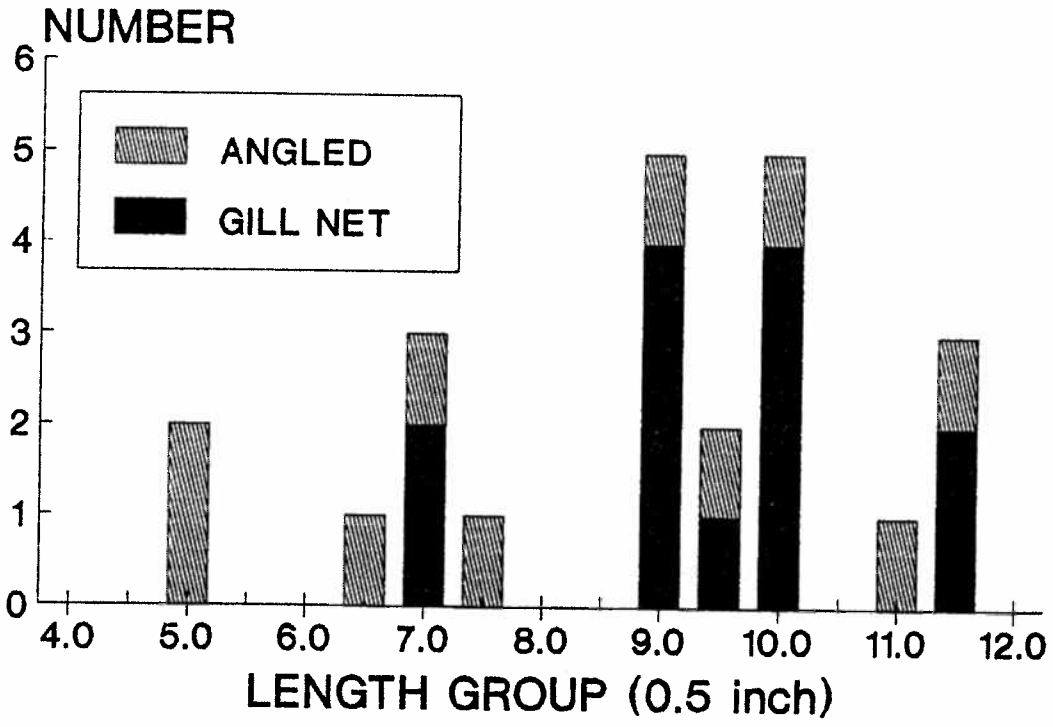

Figure 2. Length frequency histogram for rainbow trout captured by anglers and in a gill net set in Blue Lake during 1990.

Campfire Lake

Campfire Lake was sampled using a gill net set at 0945 AM August 27 and retrieved at 0820 AM on August 28. A total of 40 Yellowstone cutthroat trout were captured. These trout averaged 9.4 inches in length and 0.29 pounds (Table 2). All but one captured fish were age two (planted in 1988) (Figure 3 and Table 1). The single six year old fish captured was planted in 1984.

Cascade Lake

Cascade Lake was sampled using a gill net set at 0900 AM August 27 and retrieved at 0745 AM on August 28. A total of seven Yellowstone cutthroat trout averaging 13.1 inches in length and 1.14 pounds were captured (Table 2). Length frequency and age information indicate Yellowstone cutthroat trout have been spawning successfully (Figure 3). The last year cutthroat were planted was 1982 (Table 1). Length frequency and age information show that numerous fish age three to six were captured (length range: 10.0 to 16.9 inches). Only one fish of 19.1 inches in length was identified as an eight year old from the last recorded plant in 1982.

Cave Lake

Cave Lake was sampled using a gill net set at 0910 AM August 27 and retrieved at 0800 AM on August 28. A total of four golden trout averaging 18.3 inches in length and 2.40 pounds were captured (Table 2). The lake was planted with golden trout in 1980 and 1984 (Table 1). The scale samples were extremely difficult to interpret, but it appears that no natural reproduction has occurred because no golden trout smaller than 16.5 inches were captured.

Cottonwood Lake

Cottonwood Lake was sampled using a gill net set at 1000 AM August 28 and retrieved at 0730 AM on August 29. A total of 35 Yellowstone cutthroat trout averaging 8.7 inches in length and 0.26 pounds were captured (Table 2). Most captured fish were age 2 (Figure 4). The presence of age 3 and 4 year old fish indicates that limited natural reproduction has occurred because there is no record of cutthroat having been planted in either 1986 or 1987 (Figure 4 and Table 1).

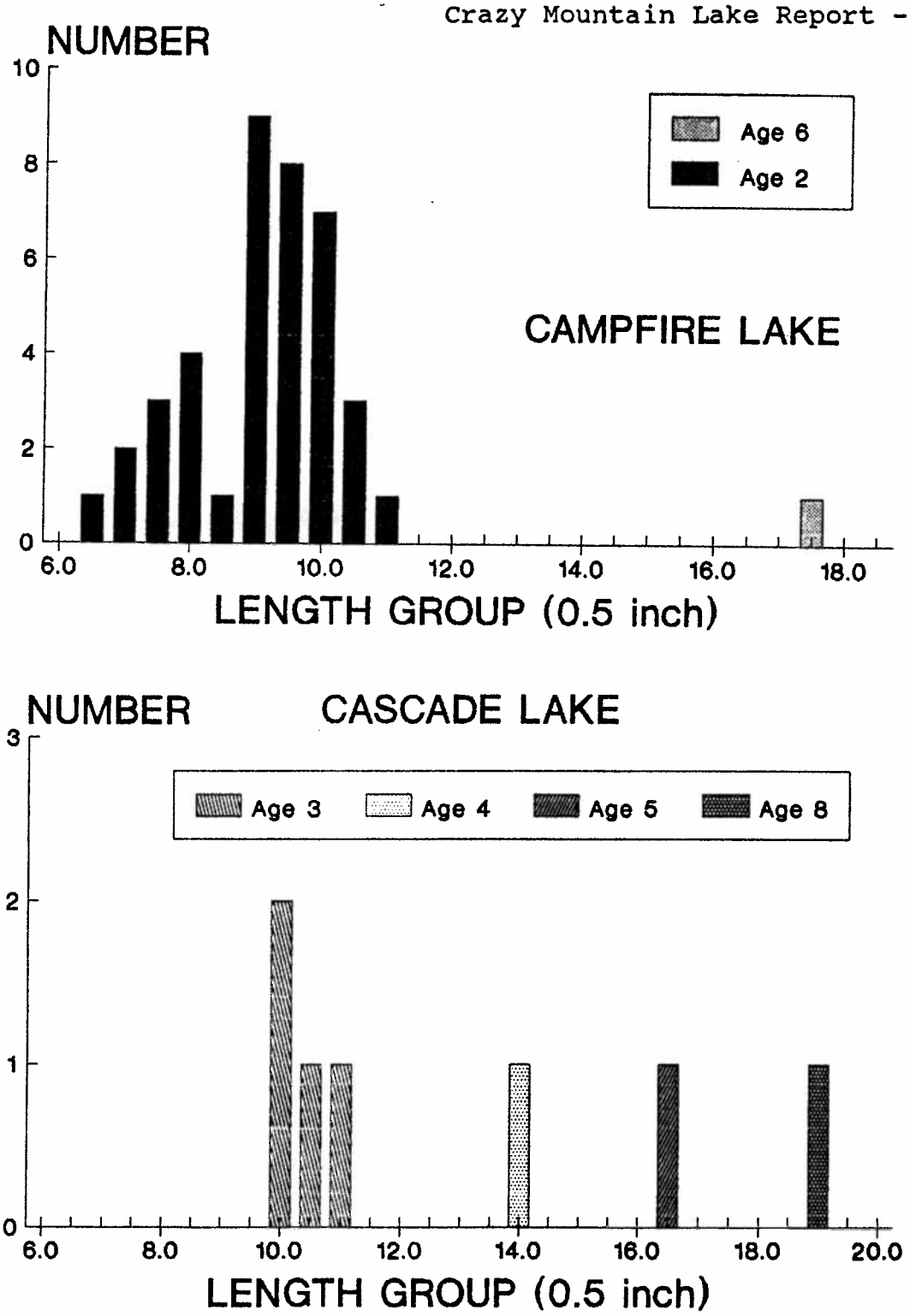

Figure 3. Length frequency histograms for cutthroat trout captured in Campfire and Cascade Lakes during 1990.

Table 2. Summary of fish sampling results for lakes in the Crazy Mountains from 1973 through 1990. Species codes are: CT = undesignated cutthroat trout; EBT = Eastern brook trout; GT = golden trout; RB = rainbow trout; and YCT = Yellowstone cutthroat trout.

Lake	Year	Species	Number per net	Average length (range)	Average weight (range)
Blue	1973	RB	5	9.1 (8.2-9.7)	0.27
	1990	RB	14	9.9 (7.0-13.6)	-
Campfire	1973	RB	5	16.1 (13.4-17.7)	1.72
	1983	YCT	31	11.0 (8.8-12.0)	-
	1990	YCT	40	9.4 (6.7-17.7)	0.29 (0.10-1.66)
Cascade	1973	EBT	1	20.5	5.12
	1980	YCT	32	11.7 (6.7-17.1)	0.85
	1990	YCT	7	13.1 (10.0-19.1)	1.14 (0.36-3.14)
Cave	1990	GT	4	18.3 (16.5-20.4)	2.40 (1.36-3.54)
Cottonwood	1972	CT	2	10.1	0.37
	1980	YCT	11	10.9 (9.5-12.2)	0.46
	1983	YCT	18	10.0 (8.1-12.2)	-
	1990	YCT	35	8.7 (6.5-15.7)	0.26 (0.09-1.21)
Druckmiller	1980	RB	14	9.6 (7.5-11.6)	0.35
	1983	RB	2	18.0 (17.8-18.2)	-
	1990	RB	16	14.9 (10.0-17.5)	-

Table 2. Continued.

Lake	Year	Species	Number per net	Average length (range)	Average weight (range)
Granite	1973	RB	11	10.2 (6.3-14.9)	0.40
	1980	RB	18	8.0 (5.6-14.4)	0.25
	1990	RB	9	8.4 (5.5-11.0)	-
Moose	1973	RB	6	10.6 (9.8-12.3)	0.48
	1980	RB	19	10.2 (6.0-15.4)	0.54
	1990	RB	15	8.4 (6.0-13.2)	0.28 (0.09-0.77)
North Fork	1973	CT	9	10.8 (7.5-13.3)	0.48
	1980	YCT	7	12.1 (8.9-14.6)	0.75
	1990	YCT	37	9.5 (6.3-14.0)	0.32 (0.07-0.94)
Pear	1980	RB	10	11.1 (8.6-13.5)	0.66
	1983	RB	2	16.4 (15.6-17.3)	-
	1990	RB	12	14.9 (12.2-18.2)	-
Rock	1972	CT	2	13.5	-
	1980	YCT	18	7.9 (6.5-10.2)	0.18
	1983	YCT	40	9.5 (6.8-15.8)	-
	1990	No fish captured			
Smeller	1980	YCT	5	16.3 (14.6-17.1)	1.77
	1983	YCT	9	12.4 (7.6-15.9)	-
	1990	YCT	7	10.7 (5.9-17.2)	0.72 (0.06-1.90)

Table 2. Continued.

Lake	Year	Species	Number per net	Average length (range)	Average weight (range)
Sunlight	1980	YCT	26	10.0 (6.1-14.3)	0.52
	1990	YCT	15	12.0 (7.1-15.2)	0.62 (0.11-1.22)
Swamp Creek	1973	EBT	22	9.6 (7.2-13.5)	0.45
	1980	EBT	28	9.9 (6.6-13.9)	0.40
	1990	EBT	19	10.0 (8.0-12.6)	0.39 (0.20-0.72)
Thunder	1973	RB	13	8.4 (6.3-12.7)	0.22
	1990	RB	13	8.6 (6.4-9.8)	-
Lower Twin	1973	RB	16	12.3 (8.0-15.5)	0.85
	1990	RB	25	8.4 (5.6-13.2)	-
Upper Twin	1990	RB	13	9.5 (5.2-12.1)	-

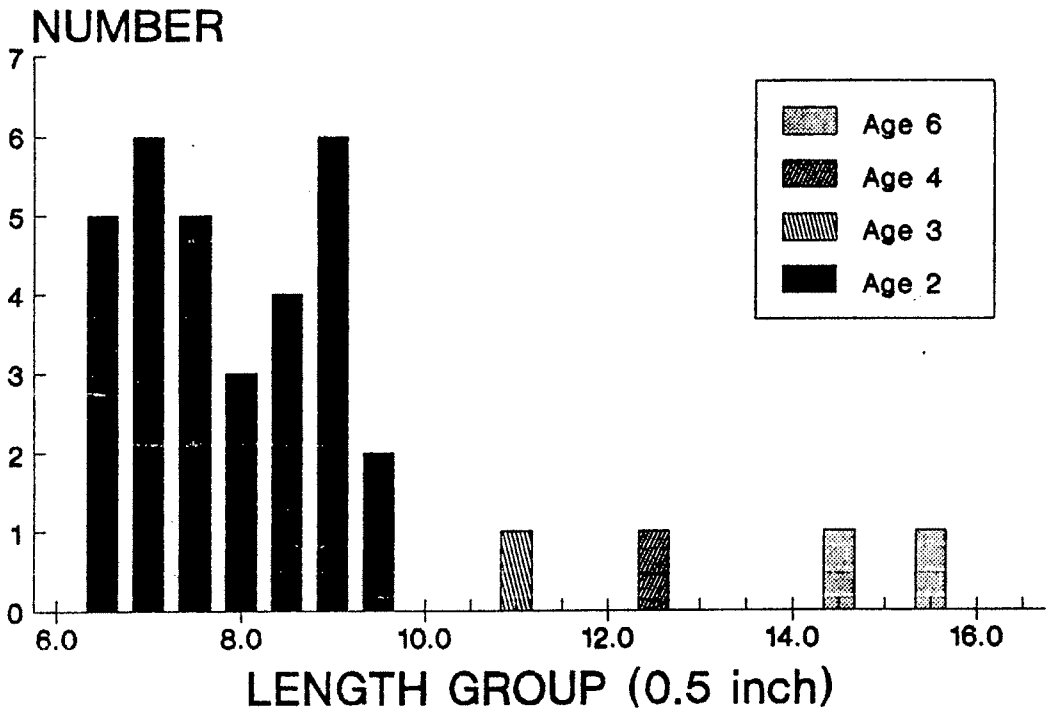

Figure 4. Length frequency histogram and ages for Yellowstone cutthroat trout captured in a gill net set in Cottonwood Lake in 1990.

Druckmiller Lake

Druckmiller Lake was sampled via angling on August 21 and by a single mountain gill net set the night of August 21 and retrieved the morning of August 22. A total of 20 rainbow trout were captured by angling. The average length of these 20 trout was 10.0 inches (range: 7.7 to 15.8). A total of 16 rainbow trout were captured in the gill net. The average length of these 16 trout was 14.9 inches (Table 2). The size of sampled fish was noticeably different between the two sampling methods (Figure 5). A cursory examination of the stomach contents of eight fish found that seven fish had consumed red zooplankton which were probably Diaptomus shoshone based on previous zooplankton surveys conducted by Marcuson (1981). Of the seven fish eating this red zooplankton, six had no other food items and one had a single caddis larvae and a single beetle. The smallest fish captured in the net, a 10.0 inch fish, had eaten only caddis larvae. Length frequency and age data indicate that some limited natural reproduction by rainbow trout has occurred (Figure 6 and Table 1). The presence of age 4 and 5 rainbow trout cannot be attributed to planted rainbow trout.

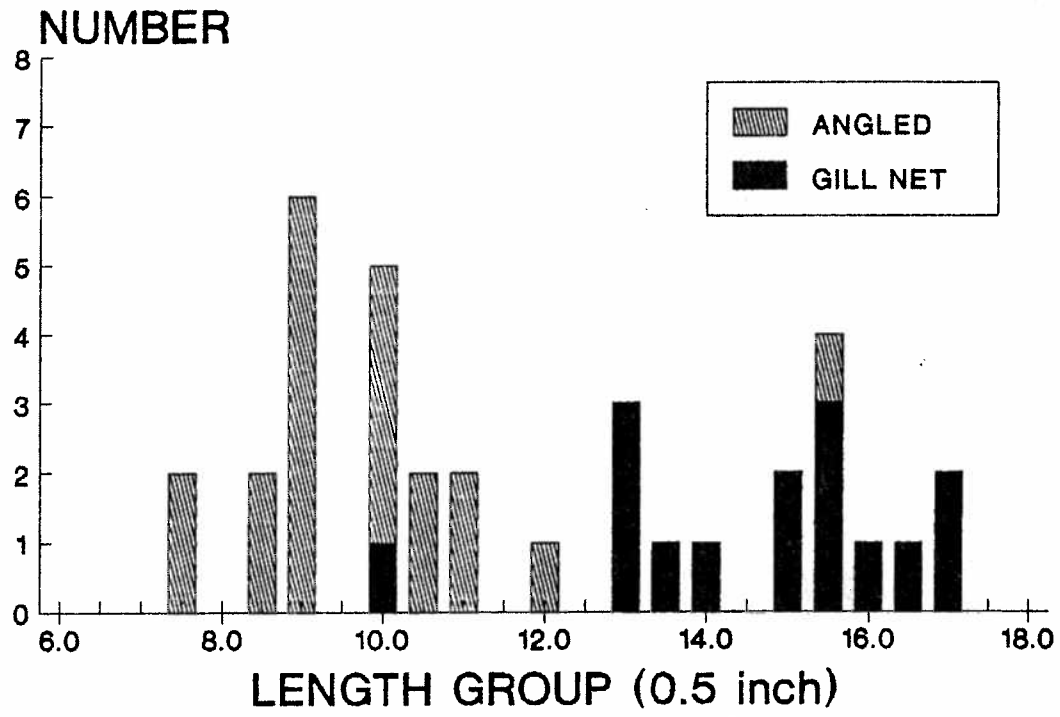

Figure 5. Length frequency histogram for rainbow trout captured by anglers and a gill net set in Druckmiller Lake in 1990.

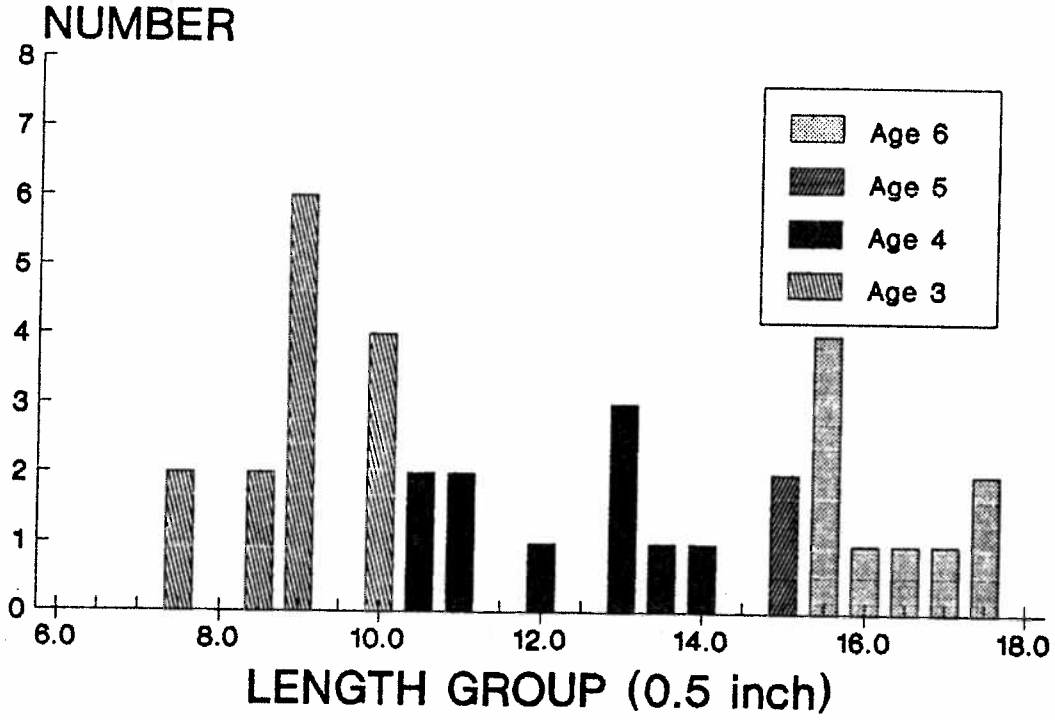

Figure 6. Length frequency histogram and ages for rainbow trout captured in Druckmiller Lake in 1990.

Granite Lake

Granite Lake was sampled via angling on August 20 and by a single mountain gill net set the night of August 20 and retrieved the morning of August 21. A total of four rainbow trout were captured via angling. These four trout averaged 8.3 inches (range: 7.0 to 10.5). A total of ten rainbow trout were captured in the gill net with one released while the net was retrieved. The average length of the nine measured trout was 8.4 inches (Table 2). A cursory examination of the stomach contents of one of the captured fish found this fish had eaten a single ant. The gill net and anglers captured similar sized fish (Figure 7).

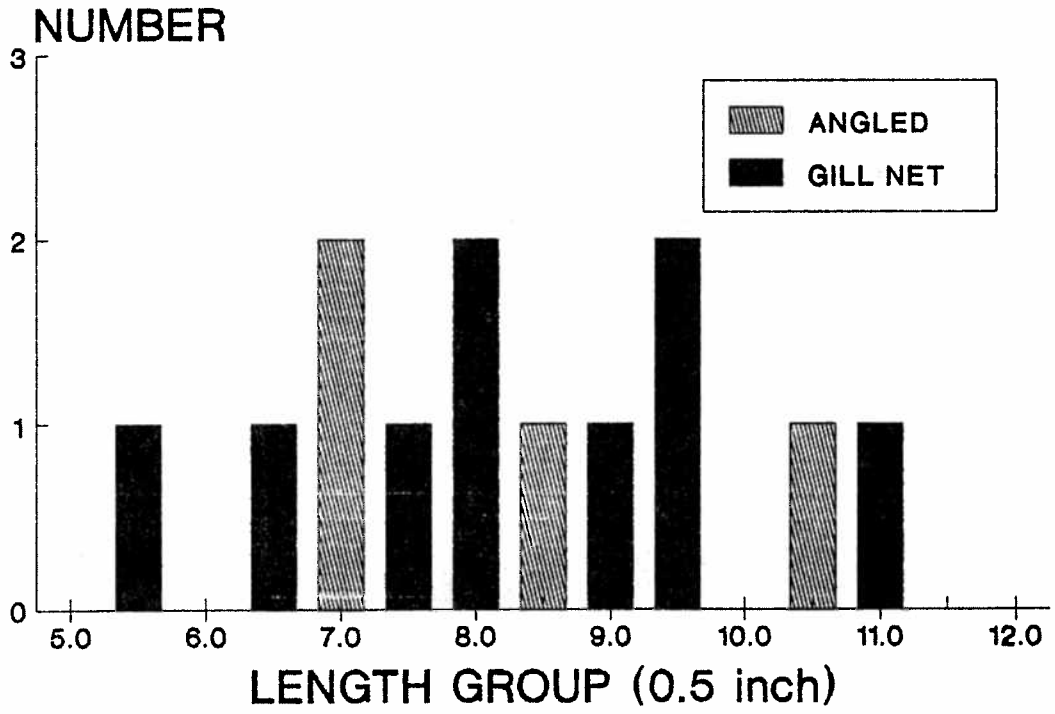

Figure 7. Length frequency histogram for rainbow trout captured using gill nets and by anglers from Granite Lake in 1990.

Moose Lake

Moose Lake was sampled using a gill net set at 0950 AM August 27 and retrieved at 0825 AM on August 28. A total of 15 rainbow trout averaging 8.4 inches long and 0.28 pounds were captured (Table 2). Length frequency information indicates different size classes were present in the lake (Figure 8). There are no recorded releases of rainbow trout into this lake.

These rainbow most likely moved up into Moose Lake from the creek.

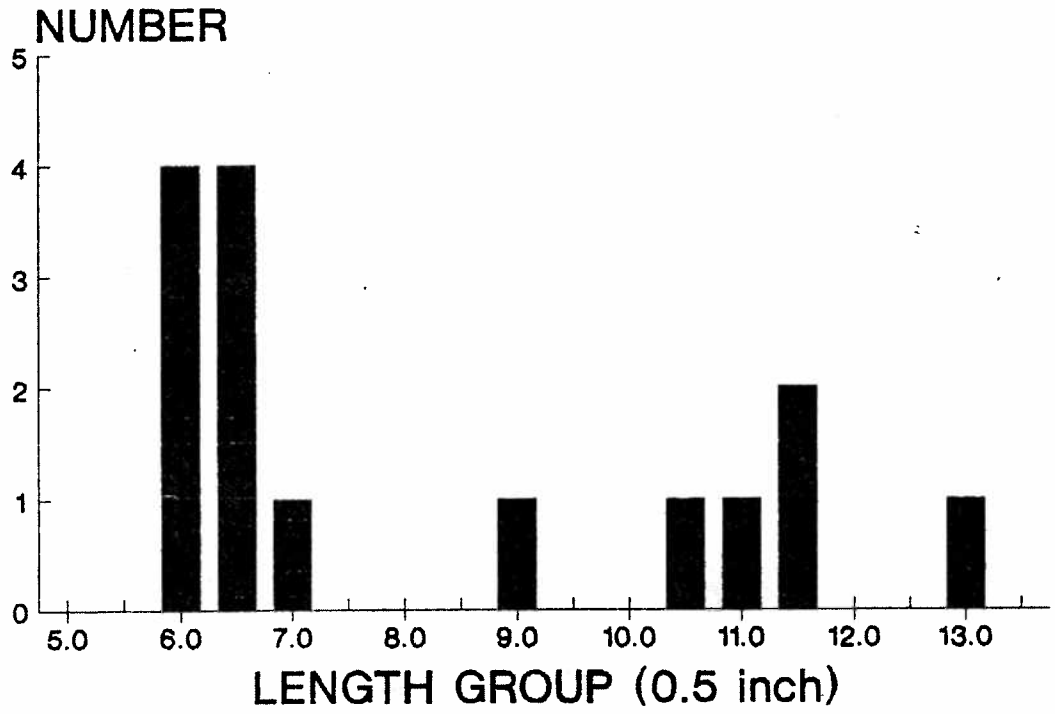

Figure 8. Length frequency historgram for rainbow trout captured in a gill net set in Moose Lake in 1990.

North Fork Lake

North Fork Lake was sampled using a gill net set at 0930 AM August 27 and retrieved at 0810 AM on August 28. A total of 37 cutthroat trout averaging 9.5 inches long and 0.32 pounds were captured (Table 2). These cutthroat trout may be introgressed with rainbow trout as both species were planted (Table 1). The trout population in the lake has been successfully reproducing naturally and several different length groups were represented in the catch (Figure 9).

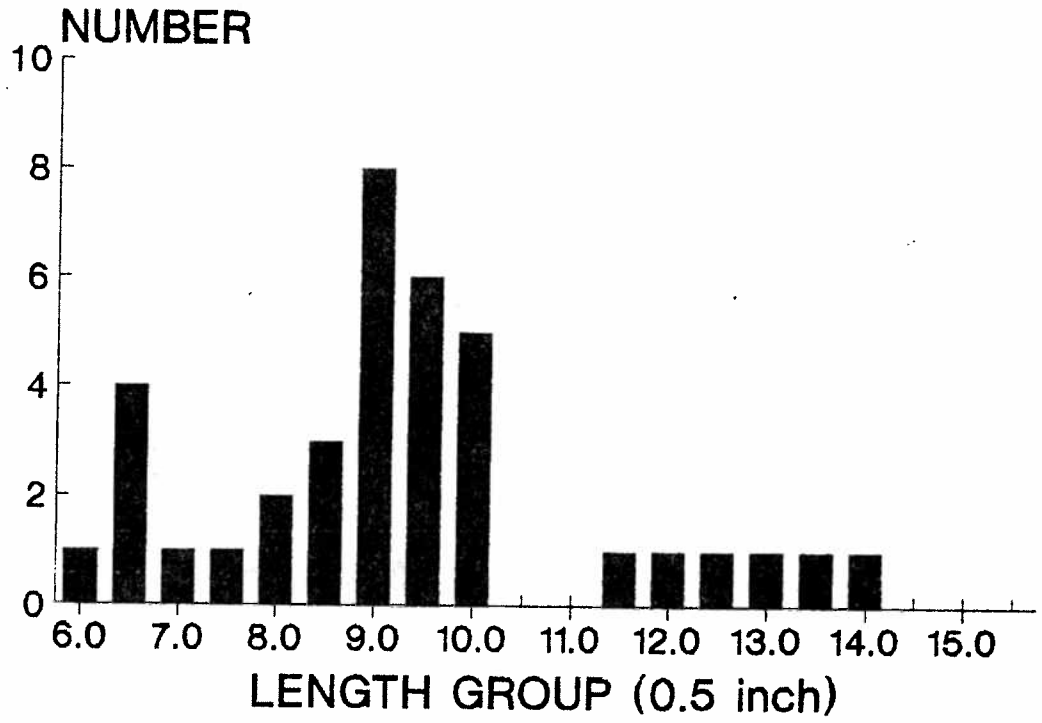

Figure 9. Length frequency histogram for Yellowstone cutthroat trout captured in gill nets set in North Fork Lake in 1990.

Pear Lake

Pear Lake was sampled by angling on August 21 and by a single mountain gill net set the night of August 21 and retrieved the morning of August 22. A total of four rainbow trout were captured by angling. The average length of these four trout was 13.9 inches (range: 12.0 to 17.1). A total of 12 rainbow trout were captured in the net. The average length of these 12 trout was 14.9 inches (Table 2). The length frequencies of fish sampled using these two methods were similar (Figure 10). A cursory examination of stomach contents found that all fish had consumed red zooplankton which were probably Diaptomus shoshone based on previous zooplankton surveys conducted by Marcuson (1981). Growth of the rainbow trout appeared variable and age/length information indicates no natural reproduction is occurring (Figure 11).

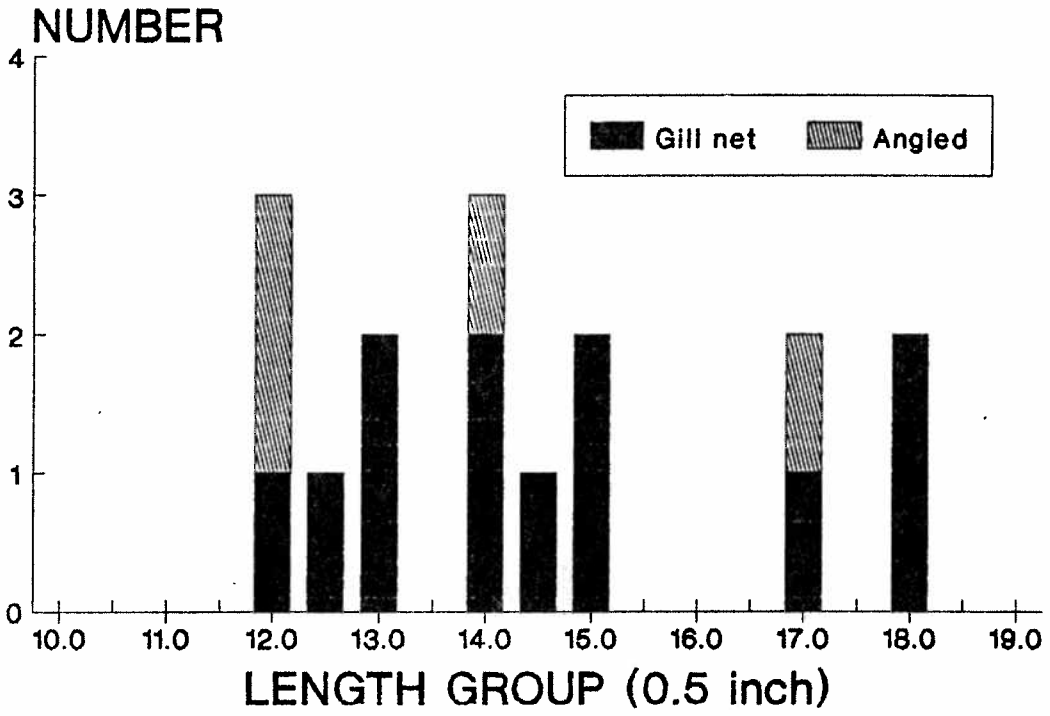

Figure 10. Length frequency histogram for rainbow trout captured by anglers and in gill nets set in Pear Lake during 1990.

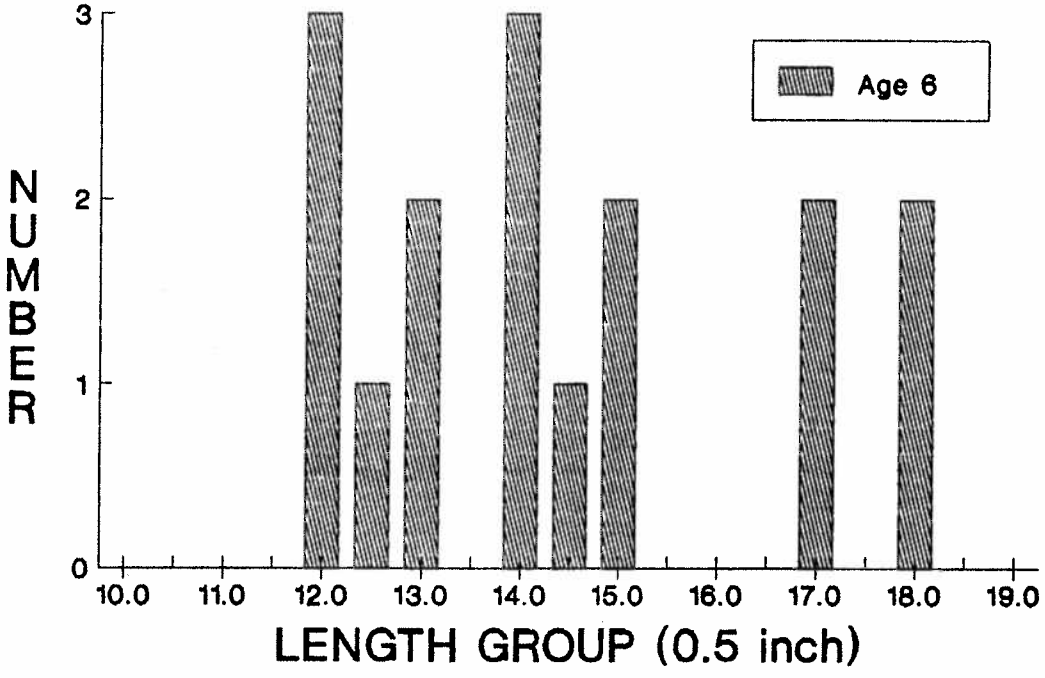

Figure 11. Length frequency histogram and age for rainbow trout captured in Pear Lake in 1990.

Rock Lake

Rock Lake was sampled using a gill net set at 1015 AM August 28 and retrieved at 0715 AM on August 29. No fish were captured.

Smeller Lake

Smeller Lake was sampled using a gill net set at 1030 AM August 28 and retrieved at 0705 AM on August 29. A total of seven Yellowstone cutthroat trout averaging 10.7 inches long and 0.72 pounds were captured (Table 2). Two distinct age/length groups were captured which resulted from fish planted in 1984 (age 6 in 1990) and in 1988 (age 2 in 1990)(Figure 12). This result indicates no natural reproduction has occurred.

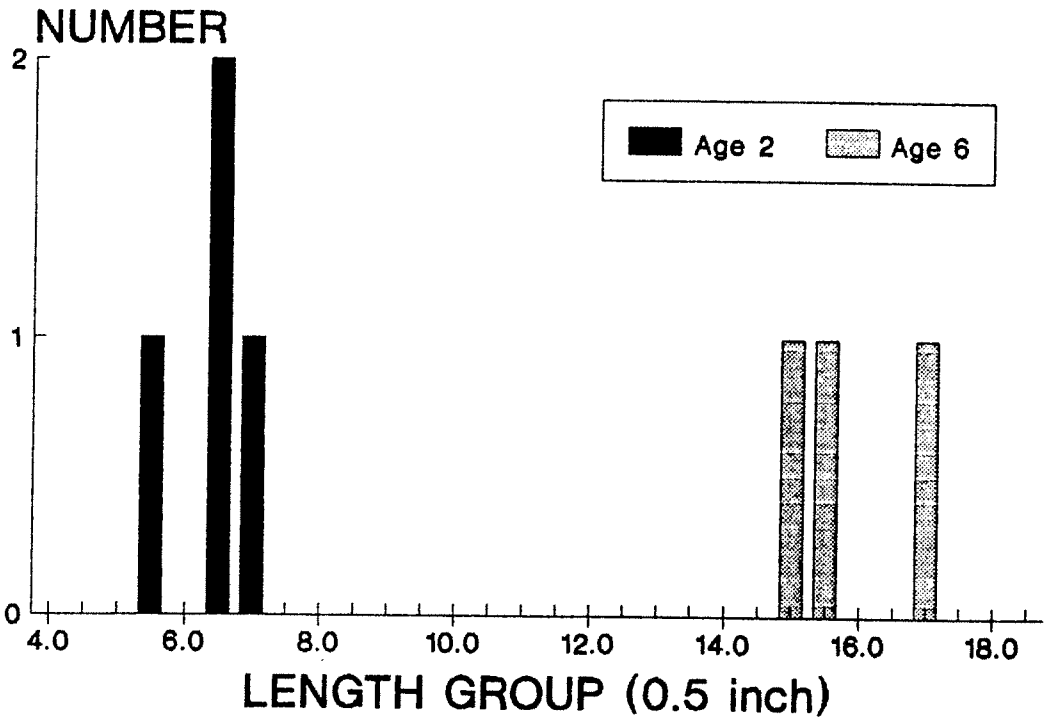

Figure 12. Length frequency histogram for Yellowstone cutthroat trout captured in gill nets set in Smeller Lake in 1990.

Sunlight Lake

Sunlight Lake was sampled using a gill net set at 0925 AM August 27 and retrieved at 0805 AM on August 28. A total of 15 Yellowstone cutthroat trout averaging 12.0 inches long and 0.62 pounds were captured (Table 2). While age 4 fish originating from the 1986 plant dominated the catch, other ages were evident which suggests natural reproduction is occurring (Figure 13).

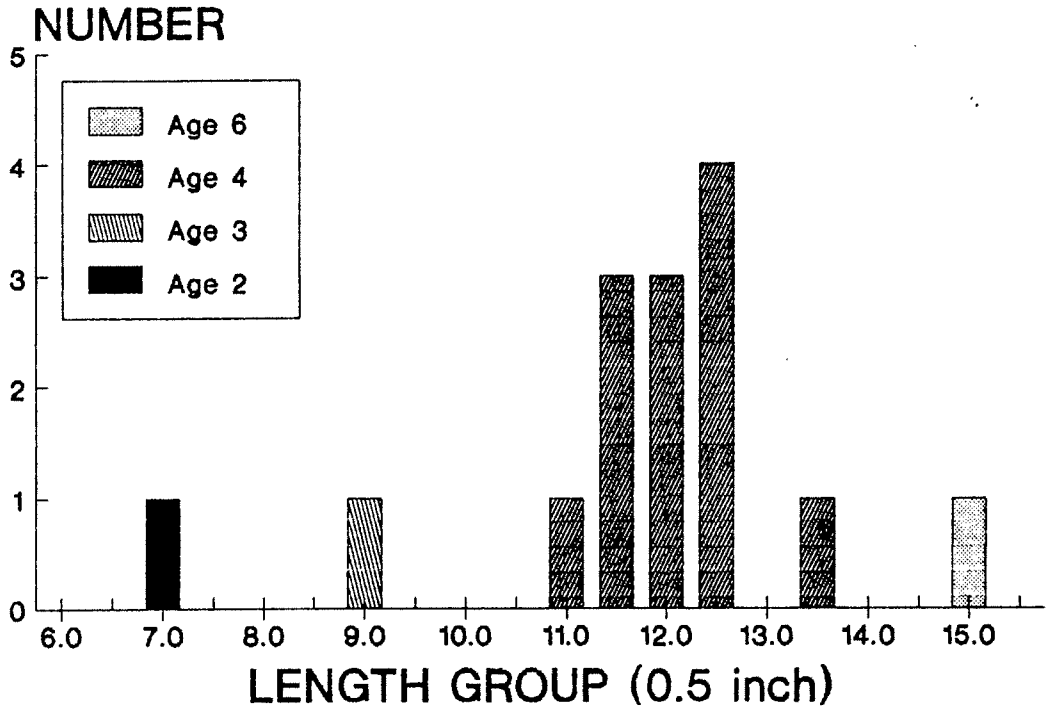

Figure 13. Length frequency histogram for Yellowstone cutthroat trout captured in a gill net set in Sunlight Lake in 1990.

Swamp Creek Lake

Swamp Creek (or Swamp) Lake was sampled using a gill net set at 1045 AM August 28 and retrieved at 0700 AM on August 29. A total of 19 eastern brook trout averaging 10.0 inches long and 0.39 pounds were captured (Table 2). Natural reproduction maintains the brook trout population in the lake and all length groups were represented in the sampling (Figure 14).

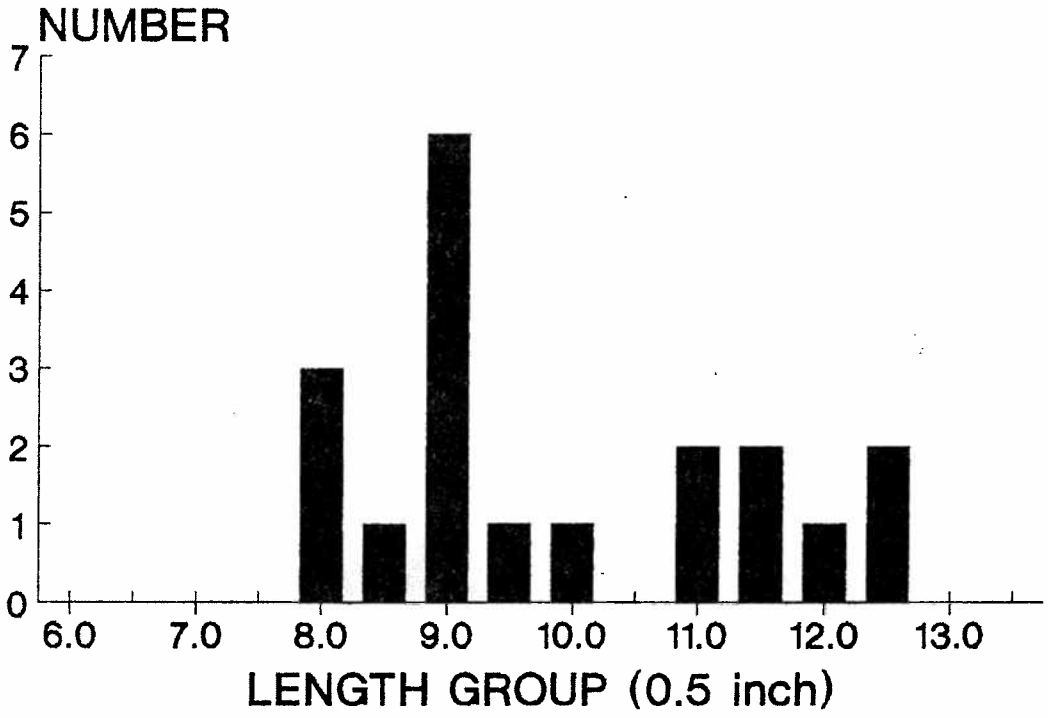

Figure 14. Length frequency histogram for eastern brook trout captured in a gill net set in Swamp Creek Lake in 1990.

Thunder Lake

Thunder Lake was sampled via angling on August 20 and by a single mountain gill net set the night of August 22 and retrieved the morning of August 23. A total of 24 rainbow trout were captured by angling. These 24 trout averaged 7.0 inches (range: 4.3 to 9.5). A total of 13 rainbow trout were captured in the gill net. These 13 trout averaged 8.6 inches (Table 2). A cursory examination of the stomach contents of a few of the captured fish found these fish were eating immature and mature forms of aquatic macroinvertebrates and a few terrestrial insects. The size range of fish captured by the two methods was similar (Figure 15).

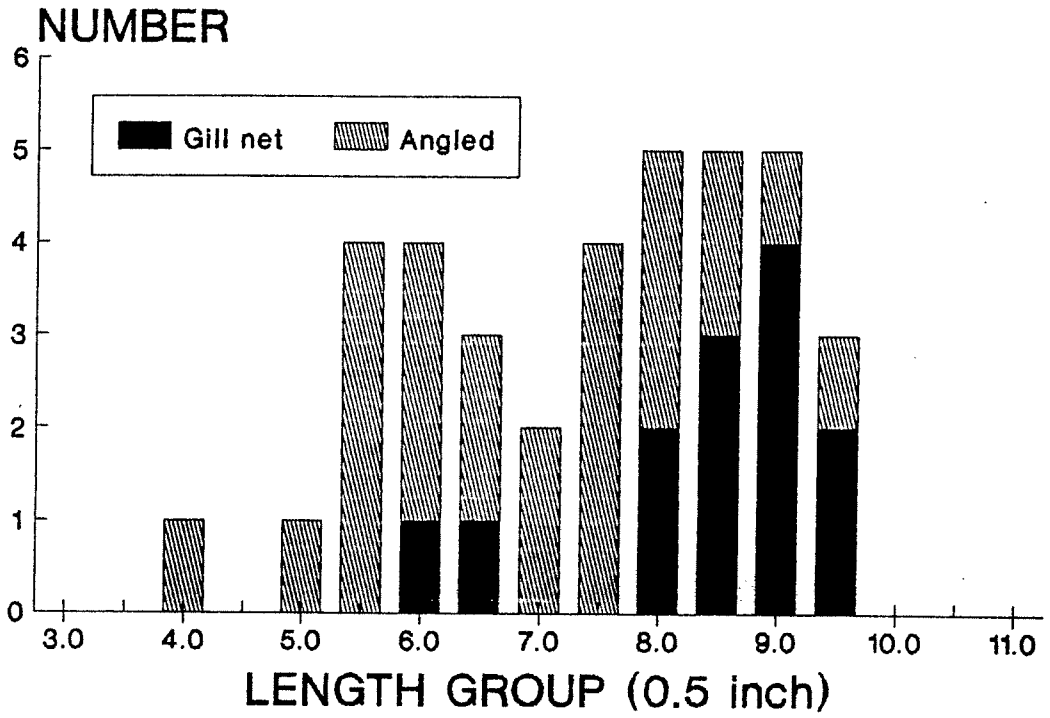

Figure 15. Length frequency histogram for rainbow trout captured by anglers and in a gill net set in Thunder Lake in 1990.

Lower Twin Lake

Lower Twin Lake was sampled using a mountain gill net set the night of August 23 and retrieved the morning of August 24. A total of 25 trout which appeared to be hybrids between rainbow and Yellowstone cutthroat were captured in the net. The average length of these 25 trout was 8.4 inches (Table 2 and Figure 16). A single 14.2 inch trout was captured by angling with little angling effort. All the trout in the upper Big Timber Creek drainage which includes Upper and Lower Twin Lakes appeared to be primarily rainbow trout, but several individuals had some Yellowstone cutthroat trout characteristics based on a cursory examination of external morphological characteristics such as the presence of a faint red slash under the jaw, the presence of basibranchial teeth, scale size, and spotting pattern. Based on the limited sampling and external examination of captured specimens, this population probably does not contain any pure Yellowstone cutthroat trout individuals.

Shoreline areas of Lower and Upper Twin lakes have been impacted by livestock use. Much of the area surrounding each lake consists of wet marshy soils and cattle trampling was evident in these areas. All the small tributaries to these lakes

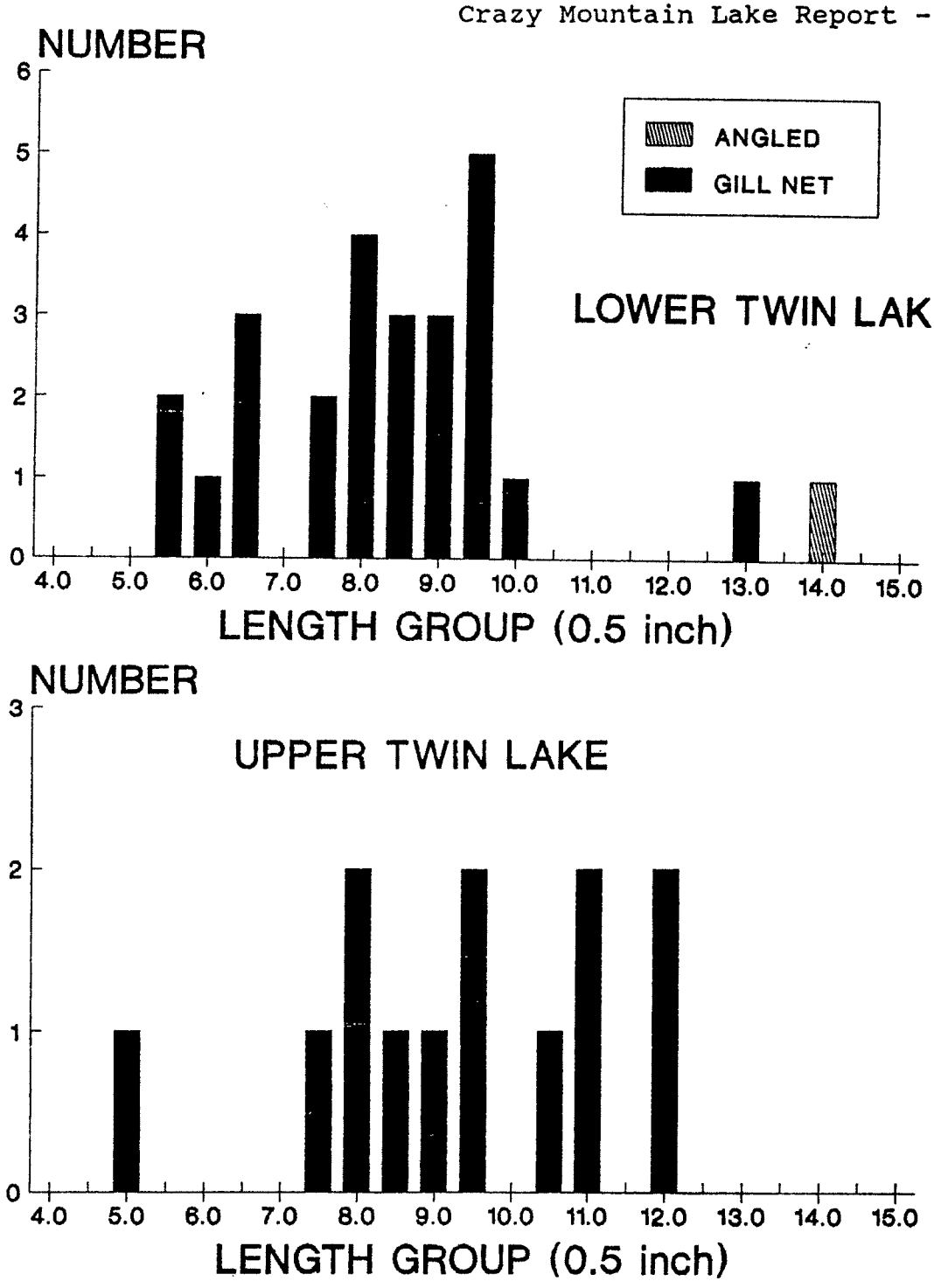

Figure 16. Length frequency histograms for rainbow trout captured in gill nets set in Lower and Upper Twin Lakes in 1990.

and Big Timber Creek in the vicinity of the lakes have been impacted by trampling with the lower ends of these tributaries being wider and shallower than would be expected. It was apparent that this area has a naturally high erosion potential and the livestock have contributed to the sedimentation of the stream and lakes. The remainder of the drainage below Lower Twin Lake is relatively resistent to livestock impacts due to the large material within the streambed and streambanks (cobble and boulder sized material) which armors the bank and bed from livestock impacts.

Upper Twin Lake

Upper Twin Lake was sampled by a mountain gill net set the night of August 23 and retrieved the morning of August 24. A total of 13 trout were captured. The discussion of hybridization between rainbow and Yellowstone cutthroat presented above in the "Lower Twin Lake" section applies to Upper Twin Lake. The average length of these 13 trout was 9.5 inches (Table 2 and Figure 16). The inlet to the lake has a streambed composed almost exclusively of sands. The above discussion on the naturally high erosion potential and livestock impacts also applies to this inlet stream.

Big Timber Creek

Big Timber Creek was fished from Thunder Creek upstream to Upper Twin Lake on August 23. A total of 57 rainbow/Yellowstone cutthroat hybrids were captured. The discussion of hybridization in the "Lower Twin Lake" section above applies to this portion of Big Timber Creek. The average length of these 57 captured trout was 8.4 inches (range: 4.0 to 14.5)(Figure 17).

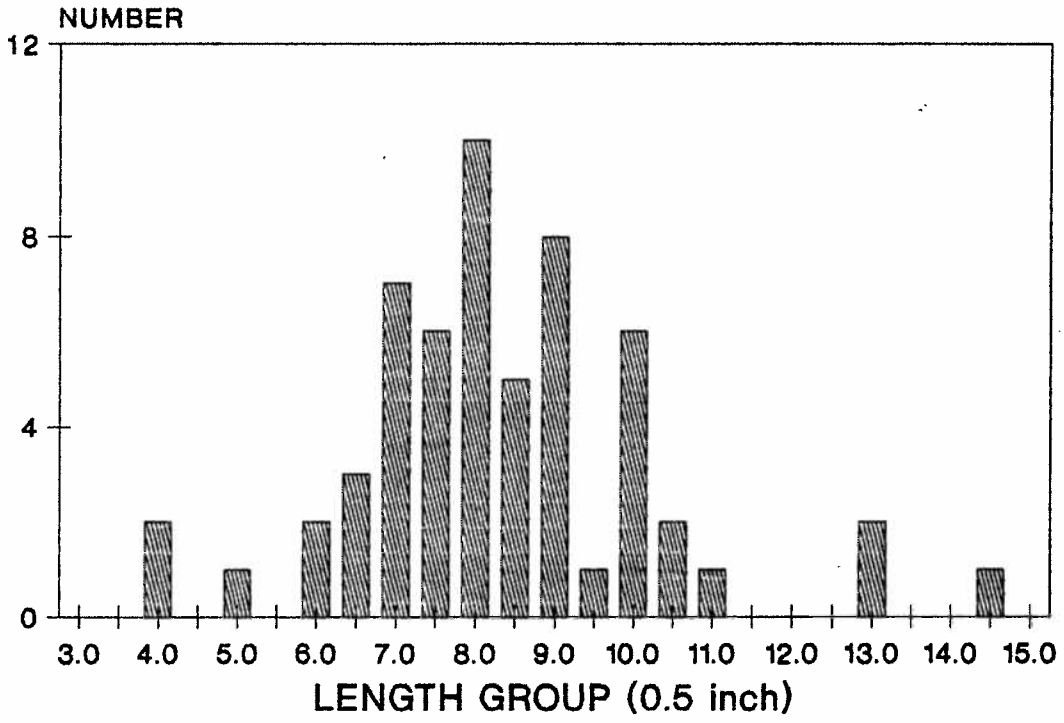

Figure 17. Length frequency histogram for rainbow/cutthroat trout hybrids captured by anglers from Big Timber Creek in 1990.

DISCUSSION

Our gill net sampling of Rock Lake captured no fish. Rock Lake was sampled in 1968 after its initial planting with 2,500 cutthroat trout in 1963 and cutthroat trout were captured (Marcuson 1981). Marcuson (1981) documented cutthroat trout in Rock Lake in both 1973 and 1980 (Table 2). Fredenberg and Swedberg (1984) captured 40 cutthroat in 1983 (Table 2). Rock Lake can support cutthroat trout populations and may provide some limited reproduction potential, but needs periodic stocking to maintain its fishery. It may have winter-killed during the past seven years, most likely the winter following the drought summer of 1988, since it is used as an irrigation water source.

The rainbow trout in Blue, Granite, Thunder, and Twin lakes originated from a plant made by Mr. Druckmiller, an early sulfite and galena miner, in the 1930's (Marcuson 1981). These rainbow have reproduced naturally since that time and maintain good populations. Blue, Granite, and Thunder lakes are linked together in a chain by short segments of low gradient stream and the rainbow trout in all three lakes appear to be members of a single population which probably move freely between the three lakes. Both Lower and Upper Twin lakes seem to function more as part of Big Timber Creek than as lakes. Both have filled in with sand size sediment and have distinct channels running through the lakes. Water retention time in both lakes is likely short and probably limits zooplankton production.

Lakes which have been planted regularly with McBride strain Yellowstone cutthroat trout provided relatively good net catches, however, some of these lakes did not hold many fish four years old and older. Campfire, Cottonwood, and North Fork lakes all had relatively high numbers of two year old cutthroat, but very few older, larger fish (Figures 3, 4, and 9). Cascade, Smeller, and Sunlight lakes had comparable numbers of various ages (Figures 3, 12, and 13). It may be that relative ease of access, which controls fishing pressure, contributes to the differences between lakes. If that is the case, it may be worthwhile to consider limiting harvest in those lakes where "trophy type" fisheries are desired and increasing stocking frequencies in those lakes where "readily catchable fisheries" are desired (terms from Marcuson 1981). Marcuson (1981) recommended management for "readily catchable fisheries" in Crazy, Cottonwood, Campfire, and lakes with self-sustaining populations. He recommended "trophy type" fisheries in Rock, Smeller, and Sunlight lakes.

Marcuson (1981) recommended that no stocking of Cascade Lake be done because that lake did not receive much fishing pressure and cutthroat trout were maintaining a population through natural

reproduction. The cutthroat trout population in the lake still appears to be maintaining itself through natural reproduction and Marcuson's original recommendation of no additional stocking should be maintained.

Our netting data from Smeller Lake did not document any cutthroat in the net catch which were positively produced from natural reproduction. All cutthroat captured were age 2 and 6 which corresponded to cutthroat planted in 1984 and 1988. Fredenberg and Swedberg (1984) indicated that natural reproduction was occurring in Smeller Lake based on 1983 sampling.

It was interesting to note that fish growth, as interpreted from scale samples, was consistently faster during 1988 than all other years. All scale samples had a relatively large growth increment inside of two annuli from the scale's margin (1989 and 1990 annuli) which related to the 1988 growth year. This fast growth year was a good indicator on scale samples. The reason for this faster growth may have been that since 1988 was a drought year, water temperatures and zooplankton production may have been higher for a longer period during the summer of 1988 than most other years. Increased water temperatures and food production would have contributed to faster growth.

Growth for known age trout planted into the various lakes was variable (Table 3). We are uncertain if the golden trout sampled from Cave Lake were all age 6 as scale impressions were difficult to read. It is possible some of these fish may have been age 10. The age 6 rainbow trout from Druckmiller and Pear lakes averaged 16.3 and 13.7 inches, respectively. This result is in direct contrast with the findings of Marcuson (1981) who reported faster rainbow trout growth in Pear Lake. Age 6 rainbow in these lakes were different strains, with Triploid rainbow from the Lewistown hatchery in Druckmiller and DeSmet strain in Pear. It may be that the Triploid rainbow trout grew at a much faster rate than the DeSmet strain.

Growth of cutthroat trout was also variable and did not appear to be directly related to stocking densities at the stocking densities observed (50 to 150 per acre). The relatively low stocking densities of 50 fish per acre in Smeller Lake produced average lengths for age 2 and age 6 fish of 6.7 and 16.0 inches, respectively, compared to 8.0 and 15.1 inches, respectively, for Cottonwood Lake which had stocking rates of over 100 fish per acre (Table 3). We are unsure if these two lakes can be directly compared because Cottonwood Lake has more shallow water areas than Smeller Lake and Cottonwood Lake is in a more open basin than Smeller. Both of these differences might lead to increased growth rates in Cottonwood Lake. Our

Table 3. Average lengths (ranges) and stocking rates (number/acre) for known age golden, rainbow and, Yellowstone cutthroat trout stocked into lakes within the Crazy Mountains and sampled during 1990.

Lake	Species	Year stocked	Age	Stocking rate (#/acre)	Average length (range)
Golden Trout					
Cave	GT	1984	6[1]/	323	19.2 (18.1-20.4)
Rainbow Trout					
Druckmiller	RB	1984	6	165	16.3 (15.5-17.5)
	RB	1987	3	165	9.1 (7.7-10.3)
Pear	RB	1984	6	101	13.7 (12.0-18.2)
Yellowstone Cutthroat Trout					
Campfire	YCT	1984	6	150	17.7 (only 1 captured)
	YCT	1988	2	149	9.2 (6.7-11.0)
Cascade	YCT	1982	8	149	19.1
Cottonwood	YCT	1984	6	109	15.1 (14.5-15.7)
	YCT	1988	2	108	8.0 (6.5-9.6)
Smeller	YCT	1984	6	50	16.0 (15.4-17.2)
	YCT	1988	2	50	6.7 (5.9-7.4)
Sunlight	YCT	1986	4	131	12.4 (11.4-13.8)

[1]/ May include age 6 and age 10 due to difficulty in reading scale impressions.

observation that lower stocking rates did not result in increased growth rates is somewhat in contrast to Marcuson's (1981) recommendation that stocking rates should be relatively low for the "trophy fisheries" lakes to promote faster growth.

The use of stocked wild strain rainbow trout in Druckmiller and Pear lakes produced different results. It appears that the Eagle Lake wild strain rainbow trout stocked into Druckmiller Lake succeeded in reproducing, but the DeSmet strain planted into Pear Lake did not successfully reproduce. This may be related more to available spawning habitat at the two lakes than to any strain differences.

The plant of Arctic grayling into Twin Lakes in 1985 did not establish a grayling population. It may be that the low stocking rate of only 300 fish total was too low to establish a grayling population. If grayling fry or fingerlings are available sometime in the future, it may be worth trying another grayling release in Twin Lakes. We would recommend a minimum of 1,000 grayling be released to provide a fair assessment of these lakes' ability to support a grayling population.

Managing for "trophy fisheries" in mountain lakes depends upon limiting harvest. The information presented above indicates that we cannot effectively increase growth rates by reducing stocking rates to produce trophy sized fish in a shorter time frame. Consequently, the only way we can produce trophy sized fish is to allow fish to reach an older age. Harvest is limited in some mountain lakes due to limited or difficult access. Where access is relatively easy, the only alternative for managing for "trophy fisheries" would be to restrict harvest. Some limited angler opinion surveys conducted with backcountry anglers entering and leaving the Beartooth Wilderness found most anglers did not want restrictions place on harvest in backcountry areas. Ironically, many of these anglers stated that they voluntarily released most fish caught.

Recommended Management Changes

1. Consider increasing stocking frequencies with a concurrent slight reduction in numbers stocked to every three years in lakes managed as "readily catchable fisheries" which have relatively easy access (Cottonwood and Campfire lakes) to increase numbers of catchable fish.

2. Increase the stocking rates in all lakes to between 100 and 150 fish per acre. It does not appear that stocking rates below 100 fish per acre provide any advantage in growth rates, while increasing stocking densities does appear to provide more fish to the populations.

3. Stock Rock Lake with 2,500 McBride strain Yellowstone cutthroat trout fry at four year intervals as recommended by Fredenberg and Swedberg (1984) to augment natural reproduction and provide a consistent fishery.

4. Stock Cave Lake once more with golden trout at a stocking rate of 5,000 and sample two years following the plant to determine if any natural reproduction by golden trout is occurring in the lake. It may be necessary to stock golden trout into Cave Lake on an eight year rotation to maintain the fishery.

5. Try another release of Arctic grayling into Twin Lakes, provided grayling are available to stock at least 1,000 fingerlings.

ACKNOWLEDGEMENTS

We would like to extend our appreciation to the Big Timber District of the Gallatin Forest for logistical support in sampling lakes within the Big Timber Creek drainage. We would like to thank Ray Zubik, Big Timber District, Gallatin National Forest; Ken Frazier, Fisheries Biologist, Montana Department of Fish, Wildlife and Parks; and Keith Iverson, Montana Department of Fish, Wildlife and Parks for their assistance in the field.

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Fredenberg, W. and S.E. Swedberg. 1984. South Central Montana fisheries study - Inventory of waters of the project area. Job Progress Report, Federal Aid Project Number F-20-R-28, Job I-a, Montana Department of Fish, Wildlife and Parks, Helena, Montana.

Marcuson, P.E. 1981. Crazy Mountains lake report. Job Progress Report, Federal Aid Project Number F-20-R-25, Job I-a, Montana Department of Fish, Wildlife and Parks, Helena, Montana.

WATERS REFERRED TO

Water name	Water code	Location
Big Timber Creek	22-0518	
Blue Lake	22-7306	T03N;R12E;Sec06CC
Campfire Lake	22-7420	T04N;R11E;Sec30
Cascade Lake	22-7448	T04N;R12E;Sec29
Cave Lake	22-7449	T04N;R11E;Sec26
Cottonwood Lake	22-7537	T04N;R11E;Sec03
Druckmiller Lake	22-7694	T03N;R11E;Sec01C
Granite Lake	22-8008	T03N;R12E;Sec01d
Moose Lake	22-8715	T04N;R11E;Sec29
North Fork Lake	22-8810	T04N;R11E;Sec08AD
Pear Lake	22-8871	T03N;R11E;Sec12
Rock Lake	22-9009	T03N;R11E;Sec11
Smeller Lake	22-9268	T03N;R11E;Sec13
Sunlight Lake	22-9366	T04N;R11E;Sec08B
Swamp Creek Lake	22-9380	T03N;R12E;Sec31
Thunder Lake	22-9464	T03N;R12E;Sec06CD
Lower Twin Lake	22-9525	T04N;R11E;Sec36C
Upper Twin Lake	22-9525	T03N;R11E;Sec02AA

Appendix A (From Marcuson 1981)

Table 1. Summary of locations, physical features and fisheries information for lakes in the Crazy Mountains

Location code[1]	Name and (numbers)	County[2]	Forest[3]	Elevation in feet	Area in acres t = total	Maximum depth in feet	Shoal (% of lake less than 15 feet deep)	Shoreline development	Fish species[4]	Fish population type[5]	Fish management[6]
	SWAMP CREEK										
1	Swamp *(near Grosfield's)*	40	G	8,350	22.2	61	21	1.2	EB	1	1
2	Hidden or Fish	40	G	8,910	5.0	63	26	1.7	CT	2	5
3	Beley (4) *(Grosfield Ranch)*	40	P	6,500	4.7t	10	100	-	B		3
	BIG TIMBER CREEK *(South Fork)*										
4	Crazy	40	G	8,700	16.9	58	19	1.2	CT	2	2
5	Lower Crazy	40	G	8,600	4.9	12	100	1.3	B		3
5a	Lost	40	G	8,640	1.9	14	100	1.2	B		3
6	Unnamed (2)	40	P	8,620	2.5t	8	100	-	B		3
	(Middle Fork)										
7	Unnamed	40	G	9,000	3.3	14	100	1.6	B		3
	(Big Timber Creek)										
8	Thunder (Lower Blue)	40	G	7,900	3.2	8	100	1.2	RB	1	1
9	Blue	40	G	7,900	10.1	42	51	1.7	RB	1	1
10	Granite (Thunder) 2 miners' lakes	40 49	P-G G	7,900	13.4 .2	95	45	1.5	RB B	1	1 3
11	Pear	49	G	8,450	39.8	185	27	1.6	RB	2	2
12	Druckmiller (Granite)	49	P	8,500	24.2	97	21	1.3	RB	2	2
13	Lower Twin	49	G	7,650	10.6	7	100	1.2	B	1	4
14	Upper Twin	49	G	7,700	6.8	6	100	1.9	B		4
15	Unnamed (3)	49	G	8,000	1.0t	3	100	-	B		3

Table 1. Summary of locations, physical features and fisheries information for lakes in the Crazy Mountains (cont.)

Location code[1]	Name and (numbers)	County[2]	Forest[3]	Elevation in feet	Area in acres t = total	Maximum depth in feet	Shoal (% of lake less than 15 feet deep)	Shoreline development	Fish species[4]	Fish population type[5]	Fish management[6]
	SWEET GRASS CREEK *(Cascade Creek)*										
16	Cascade	40	P	8,450	6.8	25	47	1.3	CT	2	5
	(Milly Creek)										
17	Hellroaring	49	G	8,300	2.4	2	100	1.6	B		3
18	Cave	49	G	8,250	15.5	41	46	1.4	GT	1	4
	(South Fork)										
19	Glacier	49	G	8,400	6.7	8	100	1.4	B		3
20	Diamond	49	G	8,750	4.4	31	32	1.1	B		1
	(Middle Fork)										
21	Moose	49	P	7,550	13.1	11	100	1.2	RB	1	1
22	Unnamed (4)	49	P(2) G(2)	7,552 8,240	5.0t	8	100	-	B		3
23	Campfire or Hindu	49	G-P	8,250	35.4	30	71	2.0	CT	2	2
24	Unnamed (2)	49	G	8,255	2.0t	3	100	1.1	B		3
25	North Fork	49	G	8,150	4.5	6	100	1.3	CT	1	1
25a	Lower North Fork Unnamed (2)	49	G(2) P(1)	8,150	1.4t	5	100	-	CT B/2	1	1
26	Sunlight	49	G	8,500	8.0	34	36	1.2	CT	2	2
26a	Lower Sunlight Unnamed	49	G	8,500	2.8t	2	100	-	CT B	2	2
	COTTONWOOD CREEK										
27	Lone	49	P	8,700	6.0	45	-	-	B		1
28	Cottonwood	49	P	8,550	9.2	36	-	-	CT	2	2
29	Unnamed	49	G	8,200	3.5	40	100	-	B		3
	ROCK CREEK										
30	Unnamed	49	G	8,200	5.0	40	100	-	B		1

Table 1. Summary of locations, physical features and fisheries information for lakes in the Crazy Mountains (cont.)

Location code[1]	Name and (numbers)	County[2]	Forest[3]	Elevation in feet	Area in acres t = total	Maximum depth in feet	Shoal (% of lake less than 15 feet deep)	Shoreline development	Fish species[4]	Fish population type[5]	Fish management[6]
31	Rock	49	P	8,550	50.0	90	-	-	CT	2	2
	(Smeller Creek)										
32	Smeller	49	P	8,800	22.0	110	-	-	CT	2	2
	COTTONWOOD CREEK *(Middle Fork)*										
33	Forest	47	L&C	8,000	23.5	30	-	-	CT	1	6

[1]See corresponding numbers on Figure 2 for locations.

[2]40 = Sweet Grass, 49 = Park, 47 = Meagher.

[3]G = Gallatin National Forest, P = Private, L&C = Lewis and Clark National Forest.

[4]RB = rainbow trout, CT = cutthroat trout, EB = brook trout, B = barren, GT = golden trout.

[5]1 = self-sustaining, 2 = stocked.

[6]1 = no management necessary, 2 = stock at intervals, 3 = no fisheries potential, 4 = stock to establish self-sustaining population, 5 = discontinue management, 6 = maintain pure strain stock.