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RAINBOW TROUT POPULATIONS IN SILVER CREEK, IDAHO, FOLLOWING A DECADE OF CATCH-AND-RELEASE REGULATIONS[1]

Michael D. Riehle, Blaine L. Parker, and J. S. Griffith[2]

Abstract.--Fish population and creel census data from 1986-87 were compared with those from 1976-77 to assess possible changes in the rainbow trout population on a portion of Silver Creek, Idaho, following 10 years of catch-and-release regulations. Growth increased slightly, total mortality declined, and the proportion of large fish in the population increased in that time interval. Fishing effort nearly doubled, and effort in a nearby section managed under general regulations declined by nearly half. The rainbow trout population in the general regulations section also showed some positive changes in the past 10 years.

INTRODUCTION

Silver Creek, a tributary of the Little Wood iver in Blaine County, Idaho, is recognized as one f the more esteemed western trout streams. Its bundant surface-feeding rainbow trout Oncorhynchus ykiss and mayfly hatches draw anglers from all reas of the country. In 1975, The Nature onservancy purchased land surrounding 2.4 km of ilver Creek and its tributaries, and catch-and-elease regulations were initiated there by the daho Department of Fish and Game (IDFG) in 1977. ne IDFG conducted an investigation (Thurow 1978) in 975 through 1977 to assess the condition of the ishery.

Our study, conducted in 1986 and 1987, focused n evaluation of the effects of catch-and-release egulations at the end of the ten year period. hanges in adjacent general regulations waters were lso assessed, and angler use of the stream was valuated in light of its increasing popularity. A etailed description of methods and results of the ntire study appears in Riehle et al. (1988); this eport reviews a portion of those results. Our ecific objectives were to:

1. describe the distribution and population structure of trout and evaluate the fishery on portions of Silver Creek managed under catch-and-release and general regulations, and

2. assess changes in the rainbow trout population and in the fishery in both areas during the past decade.

STUDY SITES

Silver Creek is largely a spring-fed system formed by the confluence of Grove and Stalker creeks. Loving Creek, the only other major tributary, enters about 3 km downstream. The IDFG Hayspur Fish Hatchery is located at the head of Loving Creek. Silver Creek flows southeasterly 42 km to its junction with the Little Wood River. The upper valley is pasture and farmland, and the lower valley is predominantly sagebrush steppe.

Peak flows in Silver Creek occur in late summer due to decreased irrigation activities and influxes of groundwater recharge. From 1975 to 1983, mean discharge ranged from 3.4 to 6.2 m^3/s. Specific conductance ranged from 275 to 434 umhos/cm. The pH varied from 7.9 to 8.7, and total alkalinity ($CaCo_3$) averaged 195 mg/l (U.S. Geological Survey 1975-1983). Summer water temperatures ranged from 10 to 22°C during the summer months, and winter temperatures ranged from 0.5 to 7.0°C.

Game fish present in Silver Creek in addition to rainbow trout included mountain whitefish Prosopium williamsoni, brown trout Salmo trutta, and brook trout Salvelinus fontinalis. Nongame

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[2]Michael D. Riehle and Blaine L. Parker were earch Assistants, and J. S. Griffith is ofessor, Department of Biological Sciences, Idaho ate University, Pocatello, Idaho.

species include bridgelip sucker Catostomus columbianus, redside shiner Richardsonius balteatus, longnose dace Rhinichthys cataractae, speckled dace R. osculus, and the Wood River sculpin Cottus leiopomus. No hatchery-reared trout were stocked in the study sections during 1986-87.

Silver Creek was divided into five study sections during the 1976-1977 IDFG study (Thurow 1978). The five sections were used for creel census, and electrofishing sites were located within those sections. We used the original creel census sections for this study, and 1986-1987 electrofishing sites 500 to 1,00 m in length were located within the areas electrofished in 1976-1977. In this paper, results from two sections (referred to as Section C&R for catch-and-release and Section GR for general regulations) are reported.

Section C&R, which was located entirely within the boundaries of The Nature Conservancy Preserve, began at the confluence of Grove and Stalker creeks and extended 3.4 km downstream to Kilpatrick Bridge. Two electrofishing sites, referred to as Upper and Lower, were located within the section. Deep silt deposits characterized the majority of the substrate, but some exposed gravel and marl areas were present. Stream gradient averaged 0.8 m/km, width was typically 20 to 30 m, and depth 1 to 3 m. The dominant macrophytes were Chara spp. Potamogeton spp. and the riparian zone contained predominantly willow Salix spp., birches Betula spp., sedges Carex spp. and grasses Poa spp..

Section GR extended from the upper Highway 20 bridge west of the town of Picabo (2.7 km below the lower end of Section C&R) 5.8 km to the Picabo Bridge. Some land is privately owned but public access is permitted, and the remainder is administered by state and federal agencies. The two electrofishing sites ranged from 10 to 45 m in width and contained some pools up to 3 m in depth. Gradient was similar to Section C & R. The substrate was primarily gravel, with silt occurring in depositional areas. The banks in the upper site supported dense growths of willows, birches, and wild roses Rosa spp.. and those in the lower site were largely open with some willow and wild rose. Potamogeton spp. was the dominant macrophyte at both sites.

METHODS

Fish Populations

Game fish populations were sampled by electrofishing at night in 1986-87. A 4.3-m-long raft was equipped with a 3500 watt generator and a variable voltage pulsator with output of 200-230 volts of pulsed D.C. at 4-6 amperes. The electrical field was established using a single boom-mounted positive and six side-mounted negative electrodes. Illumination was provided by two bow-mounted 150 watt floodlights.

Electrofishing runs were started immediately after dusk and continued for three to five hours. Sampling was done at night due to the high angler densities during the day, particularly in the catch-and-release area. Total lengths of fish collected were recorded to the nearest millimeter and weights to the nearest gram. A scale sample was removed from the area just below and posterior to the dorsal fin from all fish collected. Fin clips were used to mark fish for population estimates.

Estimates of population size were made for all electrofishing sites sampled in the summer of 1986. Upper sites only were sampled in the fall of 1986 and all sites were sampled in the spring of 1987. Population estimates were calculated using the Chapman modification of the Schnabel estimate. With this technique, multiple mark and recapture runs are made through a study site over a number of days. We utilized five to six runs for each population estimate when possible. Ninety-five percent confidence intervals were calculated for each estimate using Ricker (1975). The following equation was used to estimate population size:

$$N = \frac{C_t M_t}{R+1}$$

Where:

- C_t = total sample taken on day t.
- M_t = total marked fish at large at the start of the tth day or any other interval.
- R = total recaptures during the experiment.
- N = the estimate of the population present throughout the experiment.

Population estimates were not made in 1976-77.

Since electrofishing in 1976-1977 was conducted during the day, we conducted matched day and night electrofishing runs in both study sections in the spring of 1987. Comparisons of length frequency and numbers of fish captured were made for rainbow and brown trout. Night sampling was the more efficient method of electrofishing for rainbow trout and brown trout in the slow-moving water that characterized the sites. Approximately three times more rainbow and brown trout were captured during the night sampling. Comparisons of length frequencies between matched day and night samples indicated only minor differences for both species.

Scales from 957 rainbow trout were read for age-growth analysis. Samples were dry mounted on glass microscope slides and a glass coverslip was taped in place over the scales. All scales were magnified 50.3 times and projected onto a Houston Hipad DT11A digitizing pad. Measurements were taken along the median anterior radius from the focus to each annulus. These data were directly entered into an Apple microcomputer and analyzed using the Disbcal program (Frie 1982).

Condition factors were calculated to assess possible changes between 1977 and 1987 samples. Survival rates were calculated from the frequency of fish in age classes, as determined by scale analysis. The Heincke method, which does not require as much strength in the age determinations of the older ages as does the catch curve (Ricker 1975), was used to calculate survival (S).

Angler Effort and Catch

Creel census was conducted for the entire angling season from late May through November 1987 in the same sections surveyed in 1977. We patterned our creel census after the one conducted by Thurow (1978), but used the cluster method with three counts per day as opposed to the four that Thurow utilized. The days and count times were selected at random using a random number generator. Counts were done on two weekdays and two weekend days in each 14-day interval. All holidays were counted, with the exception of Thanksgiving Day. The count schedule was reduced to one weekend day and two weekdays after Labor Day weekend.

Angler effort was estimated using the method used in 1977, where angler effort for each interval is XWD(H) + X_1WE(H), with

X_1(X) = or the mean number of anglers:

X_1 = $\frac{\text{total anglers counted on weekends}}{\text{total number of counts}}$

X = $\frac{\text{total anglers counted on weekdays}}{\text{total number of counts}}$

WD = The total number of weekdays in the interval.

WE = The total number of weekend days in the interval.

H = The mean daylight hours per interval, taken from the sunrise and sunset timetable for Twin Falls, Idaho.

The same procedure was utilized for holiday counts.

Angler catch and harvest information was calculated for each interval from the interview data. Catch per hour and harvest per hour were estimated by dividing the total number of hours fished (from interviews) by the total number of fish captured or harvested for that interval. The resultant values were then multiplied by the total estimated hours of effort for that interval to calculate the estimated catch and harvest.

RESULTS

Fish Populations

Species Composition

For fish longer than 100 mm, the proportion of wild rainbow trout captured by electrofishing within Section C&R increased from 57% in 1976 to 80% in 1986-87 (Table 1). Hatchery rainbow trout accounted for 1% of the numbers in 1976, and fish that escaped from the Hayspur Hatchery comprised that same percentage in 1986-87. Mountain whitefish made up 40% of the 1976 sample but only 8% in 1986-87. We are uncertain whether this change is due to a reduction in density of whitefish or an increase in trout. Brown trout, which were first observed on the Conservancy

Table 1.--Species composition in percent of total catch of game fish captured by electrofishing during the 1976 and the 1986-87 field seasons on Silver Creek, Idaho. Data for 1976 from Thurow (1978).

Study site and sample period	Wild trout rainbow	brown	brook	hatchery rainbow	mountain whitefish	sample size
Section C&R						
Apr, Jul, & Nov 1976	57	0	2	1	40	504
Jul & Oct 1986, May 1987	80	6	5	1	8	1220
Section GR						
Apr, Jul, & Nov 1976	65	0	2	28	4	199
Jul & Oct 1986, May 1987	62	34	1	3	<1	656

Preserve in 1981, increased to 6% of the fish population in the C&R section in 1986-87. Brook trout increased from 2% to 5%.

In Section GR, the proportion of wild rainbow trout decreased slightly from 65% in 1976 to 62% in 1986-87. Hatchery rainbow trout stocked in the section made up 28% of the 1976 sample. Hatchery escapees accounted for 3% in 1986-87. Brown trout increased from zero in 1976 to 34% of the population in the GR section in 1986-87.

Size Composition

In the summer and fall of 1976, 3% of the rainbow trout collected by electrofishing in Section C&R exceeded 400 mm (Thurow 1978). In 1986, 16% and 23% of the electrofishing sample consisted of this size class in summer and fall, respectively (Table 2). There was a consistently higher percentage of rainbow trout longer than 400 mm in each of the 1986 and 1987 samples for the upper site of Section C&R as compared with the 1977 sample.

Section GR had a lower percentage of rainbow trout longer than 400 mm in 1986-87 than did Section C&R, but the latter did show an increase from 1977. The largest percentage, 14%, occurred in the fall of 1986. In fall 1977, 4% of the rainbow trout there were over 400 mm in length.

Seventeen percent of the brown trout electrofished in Section C&R exceeded 500 mm in length, although about three-fourths of the fish were smaller than 300 mm. Samples for Section GR were dominated by large fish. The summer 1986, fall 1986, and spring 1987 samples had 23, 33, and 25% of brown trout greater than 500 mm in length, respectively.

Trout Density and Biomass

Estimates of wild rainbow trout density for fish longer than 100 mm were generally at the level of 200-300 fish/hectare in both sections (Table 3). Densities increased in spring 1987 due to full recruitment to our sampling gear of yearling trout and, in the C&R Section, an apparent influx of fish that had reared upstream.

Brown trout densities were generally 20-40 fish/hectare (Table 3). The upper site in Section GR experienced a substantial increase in the concentration of brown trout in the fall of 1986, with densities increasing from 30 to 189 brown trout/hectare from the summer to the fall as fish congregated for spawning.

The highest rainbow trout biomass, 169.6 kg/hectare, was estimated for the upper site in Section C&R in the spring of 1987 (Table 4). Section C&R maintained a rainbow trout biomass twice or more of that of Section GR at all sample periods. Because mean weight of brown trout consistently exceeded that of rainbow trout, brown trout biomass in the upper site of Section GR often was similar to, or exceeded, the biomass of rainbow trout.

Age and Growth

In 1976-77, back-calculated length of rainbow trout at ages 1-4 was consistently greater at Section GR than at Section C&R (Table 5). Ten years later, length at ages 1-4 on Section C&R increased by 5-14 mm (not statistically significant), and length in Section GR was less than in 1976-77 (change significant for age-1 fish).

Table 2.--Length frequencies of rainbow trout in catch-and-release and general regulations sections of Silver Creek in 1977 (data from Thurow 1978) and 1986-87. Values shown are percentages of the electrofishing samples for each section.

Study site	Date	Length class in millimeters: 100-199	200-299	300-399	400-499	>500	Sample size
Section C&R							
	Fall 1977	26	37	34	3	0	202
	Summer 1986	37	28	19	16	0	234
	Fall 1986	40	20	17	23	0	180
	Spring 1986	48	18	24	11	0	530
Section GR							
	Fall 1977	22	50	24	4	0	105
	Summer 1986	66	10	20	4	0	90
	Fall 1986	11	53	22	13	1	71
	Spring 1986	53	17	25	5	0	236

Table 3.--Density estimates (fish/hectare) for wild rainbow trout and brown trout >100 mm in Silver Creek study sections, values in parentheses are 95% confidence limits.

Study site	Area, hectares	Rainbow trout Summer 86	Fall 86	Spring 86	Brown trout Summer 86	Fall 86	Spring 86
Section C&R							
upper	2.9	305 (197-469)	281 (185-423)	804 (615-1048)	—[a]	—[a]	44 (22-88)
lower	6.6	253 (161-392)			4 (2-7)		
Section GR							
upper	2.0	172 (97-294)	—[a]	323 (235-443)	30 (19-47)	189 (114-309)	44 (33-57)
lower	1.4	234 (111-451)			—[a]		

—[a] insufficient recaptures for valid estimate

No rainbow trout older than age 4 were collected in the 1976-77 study. Samples collected in 1986 and 1987 from both sections showed an additional age class, with a total of fourteen age-5 rainbow trout captured in both years. In Section [illegible] three age-5 fish were found in the spring 1987 sample only.

Differences in condition factors of rainbow trout between 1977 and 1987 samples (Table 6) and between sections in 1987, were not significant using the Mann-Whitney test and length-weight regression analysis.

Brown trout mean length at age was substantially higher than that of rainbow trout in respective sections. In Section GR, mean length at age 1 was 157 mm, as compared with 122 mm for rainbow trout. For all ages, brown trout were larger than rainbow trout of the same age. Also, brown trout exhibited greater longevity than rainbow trout, attaining a maximum of 7 years.

Table 4.--Estimates of biomass (kilograms/hectare) based on densities and average weight of rainbow and brown trout larger than 100 mm in Silver Creek. Values in parentheses are 95% confidence limits.

Study site	Rainbow trout Summer 86	Fall 86	Spring 87	Brown trout Summer 86	Fall 86	Spring 86
Section C&R						
upper	79.3 (51.2-121.9)	84.6 (55.7-127.3)	169.6 (129.8-221.1)	—[a]	—[a]	23.7 (10.8-47.4)
lower	105.8 (67.3-196.0)			3.8 (1.9-6.6)		
Section GR						
upper	31.0 (17.5-52.9)	—[a]	55.9 (40.7-76.6)	29.0 (18.4-43.6)	205 (123.9-335.9)	33.0 (24.7-42.7)
lower	40.5 (19.2-78.0)			—[a]		

—[a] no valid population estimate

Table 5.--Back-calculated lengths for rainbow trout in Silver Creek in 1976-77 and 1986-87. Asterisk denotes a significant difference between samples using a two sample t-test ($P < 0.05$). Data for 1976-77 from Thurow (1978). Number of fish per age class is given in parentheses.

Study site and source	Sample size	Estimated length at age, mm 1	2	3	4	5
Section C&R						
1976-77	77	112(13)	208(27)	280(24)	349(3)	
Oct 1986 and May 1987	505	126(262)	213(69)	294(79)	358(81)	389(14)
Section GR						
1976-77	52	139(9)*	212(26)	297(9)	361(8)	
Oct 1986 and May 1987	256	122(133)*	205(47)	268(36)	347(37)	426(3)

Table 6.--Condition factors (K) of Silver Creek rainbow trout for 1976-77 (from Thurow 1978) and 1986-87 sampling periods.

Sampling period and size classes	Mean condition factor 1976-77	1986-87	Sample size 1976-77	1986-87
Section C&R				
Fall				
<200 mm	1.00	1.04	5	32
200-299 mm	0.99	1.01	15	33
300-380 mm	1.01	0.99	13	18
>380 mm	1.01	0.97	4	52
Spring				
<200 mm	0.89	1.02	1	244
200-299 mm	1.03	1.01	4	96
300-380 mm	0.96	0.98	4	94
>380 mm	0.94	0.93	2	67
Section GR				
Fall				
<200 mm	1.28	1.10	6	8
200-299 mm	1.06	1.11	6	37
300-380 mm	0.93	1.05	2	14
>380 mm	1.02	1.04	6	11
Spring				
<200 mm	0.91	0.91	2	94
200-299 mm	0.97	0.98	13	35
300-380 mm	1.06	0.96	8	43
>380 mm	1.05	1.03	2	10

Table 7.--Total estimated effort on Silver Creek for the 1977 and 1987 angling seasons. Data for 1977 from Thurow (1978).

Study section	Surface area (hectare)	Total estimated effort, hours 1977	1987	hours/hectare 1977	1987
Section C&R	13.1	7,772	14,514	594	1,110
Section GR	22.2	11,963	6,417	538	289
Total	35.3	19,735	20,931		

Mortality

Annual mortality of adult rainbow trout age 3 and older was reduced in both sections in 1986-87 from that of 1977. Annual mortality (A) in our study ranged from 0.44 to 0.53 for various time intervals in Section C&R, a decrease from 0.67 in 1977.

For Section GR, both 1986 and 1987 annual mortality estimates (0.67 and 0.42, respectively) were also less than the 0.72 value determined in 1977. The exploitation rate (E) of age 3 and older rainbow trout there was 0.38.

Angler Effort and Catch

Total angling effort for the two sections of Silver Creek increased slightly from 1977 to 1987, from 19,735 to 20,931 hours (Table 7). The distribution of effort changed dramatically, however, with that of Section C&R nearly doubling (to 1,110 h/hectare) and that of Section GR decreasing by nearly half to about 290 h/hectare.

Catch rates for rainbow trout in Section C&R increased from 1.13 fish/h in 1977 to 1.81 fish/h during the 1987 season (Table 8). Catch rates of trout ≥ 300 mm increased from 0.42 fish/h in 1977 to 0.74 in 1987. The increase in catch rate and effort resulted in a threefold increase in estimated number of rainbow trout caught from 8,803 in 1977, the first year of catch-and-release, to 26,213 in 1987 (Table 7).

The length frequency (based on angler recall) of angler-caught rainbow trout in Section C&R was similar to that generated from electrofishing samples for trout up to 400 mm. For fish over 400 mm, however, anglers captured a smaller fraction (9%) in the section than did electrofishing (19%). There was no substantial change in size of rainbow trout caught by anglers in the 10 year period; fish longer than 300 mm comprised 41% of the 1987 catch, as compared with 37% in 1977 (Table 9). Brown trout and brook trout in Section C&R comprised 8% and 2.5% of the catch, respectively.

In Section GR, the proportion of fly fishermen increased from 38% in 1977 to 61% (38% bait and 1% lures) in 1987. Only 28% of fish caught in Section 3 in 1977 were wild rainbow trout, as compared to 86% in 1987 (Table 8). The total catch rate for rainbow trout in Section GR increased over the last 10 years from 0.24 fish/h in 1977 to 1.38 fish/h in 1987.

Table 8.-- Estimated catch of rainbow trout in the 1977 (from Thurow 1978) and for all trout species the 1987 angling seasons. Catch rates (fish/h) are in parentheses.

Study section	1977 rainbow	1987 rainbow	brown	brook
Section C&R	8,803 (1.13)	26,213 (1.81)	1,221 (0.08)	688 (0.05)
Section GR	2,846 (0.24)	8,856 (1.38)	1,356 (0.21)	141 (0.02)

Table 9.--Mean lengths of angler-caught wild rainbow trout and percentages of the catch that exceeded 300 mm and 400 mm for the 1977 and 1987 angling seasons. Data from section C&R from angler recall and from section GR from measurements of harvested fish. Data for 1977 from Thurow (1978).

Stream section	1977 mean length, mm	1977 % > 300 mm	1977 % > 400 mm	1977 sample size	1987 mean length, mm	1987 % > 300 mm	1987 % > 400 mm	1987 sample size
Section C&R	285	37	8	898	255	41	9	1168
Section GR	280	44	8	146	286	49	6	55

The proportion of rainbow trout exceeding 300 mm harvested by anglers in Section GR also increased from 44% to 49% during the ten years (Table 9). Our creel census indicated that 15% of the rainbow trout caught (regardless of whether they were released or harvested) in Section GR were larger than 300 mm in 1987. Harvest rates of rainbow trout in the section have almost doubled since 1977, from 0.16 to 0.28 fish/h. The number of rainbow trout harvested in 1987 decreased slightly to 1,805 from 1,924 fish in 1977, due to the reduction in effort and an increase in the percentage of rainbow trout released from 32 to 80%.

Brown trout in Section GR accounted for 13% of the catch in 1987. The total estimated catch during the season was 1,356 brown trout, of which an estimated 437 were harvested.

DISCUSSION

In evaluating the effects of catch-and-release regulations on Silver Creek, both biological and sociological changes may be evaluated. The former would be reflected in a response of the fish populations, and the latter would be evident in the fishery.

Our study demonstrates sociological changes in the past decade that were much stronger than the biological changes. Although angler effort on Silver Creek as a whole has remained quite similar since 1977, effort in the catch-and-release section has more than doubled. This increase is not solely due to an increase in nonresident use, as little change in residence of anglers occurred (Riehle et al. 1988). Effort in the section that continued under general regulations declined by nearly half. This decline was unfortunate from a research perspective because it confounded analysis of trout population dynamics in that section.

The biological indicators of change that we had the opportunity to evaluate for both study sections were the frequency of large fish in both the electrofishing sample and in the catch, and the angler catch rate. These indicators, with one possible exception, suggest success in the catch-and-release portion of Silver Creek during the past ten years of special regulations.

Because our evaluation depends upon point estimates made at the beginning and end of the interval and not periodically through it, drastic fluctuations in population levels caused by extrinsic factors such as floods and droughts could mask any effects of regulation change. As a spring-fed system, Silver Creek is largely immune from those effects and, we believe, its population dynamics are similar to those in spring streams such as Lawrence Creek, Wisconsin, where trout populations remained relatively stable over a number of years (Hunt 1974 and 1976).

One important question that this study cannot definitively address is whether the number of rainbow trout, especially the number of large trout, has increased during the period in either study section. Since no population estimates using electrofishing were made in the 1976 and 1977 field seasons, only inference based on catch rates is possible, and this requires the assumptions that angler ability and susceptibility of trout to capture have not changed in the 10-year period. If that is the case, rainbow trout populations in the catch-and-release section may have increased at a level commensurate with the 160% increase in catch rate, and those in the general regulation section may also have increased, as discussed below.

Rainbow trout in the 400-499 mm size class in the catch-and-release section increased from 3% to 23% of the electrofishing sample. An increase in size in the angler catch was not evident. One possible explanation is that the larger trout were becoming less vulnerable to repeated hooking. Our data indicate that, on average, each rainbow trout was captured about three times during each angling season (Riehle et al. 1988). Another possible explanation is that larger rainbow trout were more vulnerable to electrofishing.

The increase in the proportion of larger fish in the population appears to reflect changes in both growth and survival. We found a decrease by about one-third in total annual mortality for rainbow trout of ages 3 and older. A similar reduction in summer season mortality (0.47-0.50 in a catch-and-release area and 0.71 in a general regulations area) has been documented for rainbow trout in the Madison River of Montana (Vincent 1980). In the Big Wood River of Idaho, annual mortality rates for rainbow trout were 0.70 in a catch-and-release area and 0.76-0.78 in a general regulations area (Thurow 1988). From these and other studies, it is becoming evident that total annual mortalities over 40% may be typical for rainbow trout in catch-and-release fisheries. There are several possible reasons for this. One, suggested by Thurow (1988), is that natural mortality is elevated in a compensatory manner over that of a population where harvest is substantial. Other possibilities are that mortality from hooking may be greater than expected and/or the impacts of repeated hooking may be synergistic.

The presence of age-5+ rainbow trout in the Silver Creek population in 1986-87 reflects the increase in survival. Increases in longevity among salmonids protected by catch-and-release regulations have been documented in studies by Johnson and Bjornn (1978), Vincent (1980), and Jones (1985).

Growth of rainbow trout in the catch-and-release section of Silver Creek has increased from estimates made in 1977. The increase, although not statistically significant, may be biologically significant. Increases in growth may have occurred from the protection afforded to fast growing individuals, assuming that these individuals would have otherwise been harvested, or may reflect a reduction of hatchery catchable rainbow trout from the section. Vincent (1987) found an increase in growth of wild brown trout in O'Dell Creek, Montana, after the elimination of hatchery catchable plantings. An ongoing program of The Nature Conservancy to reduce sediment input from the upper tributaries may have also increased the productivity of Silver Creek and increased trout growth.

The moderate response of Silver Creek rainbow trout to special regulations may be due to inherent characteristics of the stock. As discussed by Thurow (1978), random introductions over the past 80 years of fish from numerous hatcheries have altered the genetic makeup of the original McCloud River stock established in the nineteeth century.

The rainbow trout population in the general regulations section has also shown improvement over the last 10 years. Total annual mortality of age-3 and older fish has fallen to a degree similar to that in the catch-and-release section, and a few age-5 rainbow trout were present. Although growth has declined since 1977, there has been a small increase in the percentage of fish exceeding 399 mm in length. The probable cause of these changes is the 46% decrease in angler effort and the substantial increase in the percentage of fish released. Harvest of rainbow trout was reduced by 37% from 1977. Another possibility, which also influenced the reduction in effort, is the cessation of rainbow trout stocking. During the 1976 and 1977 study years, approximately 12,000 catchable-sized rainbow trout were planted in the section.

The number of rainbow trout caught by anglers in the general regulations section has tripled and the catch rate has increased nearly six-fold in the interval. Although the percentage of fish released has increased to 80% of that caught, the fishery continues to provide substantial harvest. We found that in 1987, anglers harvested an estimated 41% and 28% of the rainbow trout present in the spring that exceeded 300 and 400 mm, respectively.

Considering that in 1977 brown trout were not found above the Picabo Bridge, the brown trout population has made strong advances in the ten years. Few anglers were successful in catching them. A few successful anglers fished at night, and they were probably not adequately covered in the interviews, but too few trips were involved to affect the harvest values. Brown trout in the catch-and-release area have become more than a novelty. Although few brown trout were caught by anglers, electrofishing and snorkel surveys in the upper portion of the section indicate a relatively high density of juvenile brown trout. With undercut banks, brushy submerged and overhead cover, and deep pools, the habitat there is well suited for brown trout, and the population should continue to expand.

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