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Population Estimates and Size Regimes of Cutthroat and Brook Trout in Diamond, Kendall, and Spring Creeks, Idaho

Abstract

Population estimates of size regimes were determined for cutthroat (*Salmo clarki*) and brook trout (*Salvelinus fontinalis*) populations during 1976 and 1977 at Diamond, Kendall, and Spring creeks, Idaho, to determine if these streams are extensively used as spawning grounds and rearing areas for the Blackfoot River and Blackfoot Reservoir trout fishery. Spring and Kendall creeks supported the largest tout densities, totaling over 4780 and 2264 fish/km. Three stations were sampled on Diamond Creek, of which only Station 1 consistently contained over 1000/km. Stations 2 and 3 had low trout densities and were affected by cattle grazing.

Reproduction was observed in November 1976 at all three streams for brook trout, whereas cutthroat trout spawned in June and July 1977. Mean standard length values for cutthroat trout at Spring Creek were always below 100 mm. This trend of large populations of small fish was also observed at Kendall and Diamond creeks, indicating that the three streams were used as rearing grounds and spawning areas.

Introduction

The Blackfoot River and Reservoir in southeastern Idaho have been extensively fished for trout. The trout fishery in the Blackfoot River drainage includes naturally reproducing, self-sustaining populations of cutthroat and brook trout (*Salmo clarki* and *Salvelinus fontinalis*). Adults of both species spawn in tributaries of the Blackfoot River and migrate back to the Reservoir after the spawning season. The tributaries are thought to be used as rearing areas by the juvenile trout. Although the contribution of tributaries of the Blackfoot River as spawning grounds and rearing areas has not been extensively documented, other examples of the use of tributaries for this purpose by cutthroat and brook trout are well known (Raleigh 1969, Raleigh and Chapman 1971, Benson 1960, Cope 1957, Carlander 1969). This study attempts to demonstrate the value of Spring, Kendall, and Diamond creeks, Idaho, as spawning and rearing areas for cutthroat and brook trout and how, with the possible advent of mining activities in the area and continuing cattle grazing on Diamond Creek, possible damage to the spawning and rearing grounds could occur.

Description of the Area

Diamond, Kendall, and Spring creeks are tributaries of the Blackfoot River, and are

located approximately 30-40 km east of Soda Springs, Idaho, in the Upper Valley. The Diamond Creek area constitutes a complex ground water system which characteristically has water infiltrating from all three streams. Spring Creek arises from several cold springs (7°C) near Diamond Creek which, along with Kendall Creek, flows north from the mountains.

Fish were collected at three locations on Diamond Creek starting below Yellow Jacket Creek at the Forest Service border in the Upper Valley. Station 1 shows little visual sedimentation or bank degradation. Bank and pool cover also appear to be excellent. The stream flows quickly, with alternating series of riffles and pools and overhanging banks with an extensive growth of willows.

Stations 2 and 3, also on Diamond Creek, are located north of the Forest Service boundary in areas of extensive cattle grazing. Both stations were affected by grazing, which resulted in heavy silt deposition, eroded banks, stream channelization, and a slower flow. Willow stands, which were evident at Station 1, had been removed or killed in the area of Stations 2 and 3. A diversion dam located downstream from Station 2 further reduced the stream flow at Station 3. Kendall Creek (Station 4) and Spring Creek (Station 5) had less siltation and better stream conditions. Both sites had alternating pool-riffle habitats, overhanging banks, and extensive growths of submerged macrophytes in the stream, with stands of willows along the banks to provide stream cover for fish.

Methods and Materials

Cutthroat and brook trout were captured at five stations on Diamond, Kendall, and Spring creeks from August 1976 to July 1977. Sampling was performed monthly until December, when heavy snows prevented access, and resumed in May, June, and July 1977. Fish were captured with a D.C. powered electroshocker, two seines, and dip nets. Seines were used to block each end of a 100 m section of stream to prevent immigration into and emigration from the area. Fish were anesthesized with quinaldrine, and weighed and measured for standard length using a spring balance and a measuring board. All fish were released after sampling at each site was concluded.

Population estimates were determined by the successive removal technique described by Libosvarsky (1966) and Carle and Strub (1978). Fish were shocked three successive times in a closed 100 m section of stream to estimate population size of the cutthroat and brook trout by a least squares regression. Fish larger than 150 m were tagged with Spaghetti Floy tags before being released.

Sediment samples were taken in the fall from pool and riffle habitats at the three sites on Diamond Creek to determine the possible effects of siltation from cattle grazing or future mining operations on the trout populations. Sediment was collected in liter bottles and preserved with 10 percent formalin before being sieved through 8.0, 5.6, 3.36, 1.0, and 0.5 mm mesh sieves. The several groups of particle sizes were weighed on a triple beam balance to determine the percent composition of each particle size per substrate sample.

Diamond, Kendall, and Spring creeks also functioned as rearing grounds for both cutthroat and brook trout. Spring Creek cutthroat trout occurred in greatest numbers during September through December, and July, although the mean standard length never exceeded 100 mm. The mean standard length at Kendall Creek exceeded 100 mm only in September and June, which supports the idea that Spring and Kendall creeks

are supporting large populations of small trout and thus serving as rearing grounds for trout in the Blackfoot River drainage.

Sediment samples from Diamond Creek were sieved into six groups of particle sizes (Table 3). Silt accumulation was found to be greatest at Station 2 in the pool area

TABLE 1. Fish population estimates for Diamond Creek, Idaho, based on electrofishing (D.C.) from August 1976 through July 1977.

sample station	Date	Population estimate Fish/km	Size range (mm)	Percent species composition (mean standard length)	
				Cutthroat Trout	Brook Trout
Diamond Cr.	02 Aug. 76	240	60-218	76 (118)	24 (129)
Station 1	03 Sept.	1,080	25-183	87 (119)	13 (104)
	18 Sept.	1,200	38-181	88 (109)	12 (92)
	17 Oct.	220	45-150	73 (60)	27 (125)
	19 Nov.	1,444	27-179	69 (81)	31 (92)
	16 Dec.	290	101-164	87 (124)	13 (137)
	07 April 77	197	40-163	67 (98)	33 (123)
	01 June	333	53-470	100 (218)	0
	05 July	1,020	57-209	88 (111)	12 (144)
Diamond Cr.	02 Aug. 76	260	62-199	100 (122)	0
Station 2	04 Sept.	1,140	30-173	93 (100)	7 (74)
	17 Oct.	300	38-115	100 (64)	0
	20 Nov.	183	52-139	100 (88)	0
	16 Dec.	900	34-68	100 (50)	0
	07 April 77	164	85	0	100 (85)
	01 June	191	65-480	83 (206)	17 (137)
	05 July	82	69-142	100 (107)	0
Diamond Cr.	03 Aug. 76	330	58-320	100 (111)	0
Station 3	19 Sept.	972	29-224	100 (79)	0
	16 Oct.	380	38-284	94 (71)	6 (163)
	20 Nov.	455	20-151	97 (61)	3 (79)
	16 Nov.	Frozen			
	07 April 77	Frozen			
	01 June	0			
	05 July	0			

TABLE 2. Fish population estimates for Kendall and Spring Creeks, Idaho, based on electrofishing (D.C.) from August 1976 through July 1977.

Sample station	Date	Population estimate Fish/km	Size range (mm)	Percent species composition (mean standard length)	
				Cutthroat Trout	Brook Trout
Kendall Cr.	03 Aug. 76	820	47-233	94 (94)	6 (131)
	10 Sept.	2,264	28-205	72 (101)	28 (77)
	16 Oct.	640	30-131	91 (62)	9 (92)
	20 Nov.	1,409	42-251	87 (96)	13 (151)
	19 Dec.	759	31-150	73 (86)	27 (90)
	07 April 77	1,049	20-233	64 (83)	36 (121)
	02 June	540	37-406	85 (130)	15 (91)
	05 July	755	29-141	51 (63)	49 (51)
Spring Cr.	18 Aug. 76	660	32-165	69 (82)	31 (80)
	19 Sept.	4,780	32-150	89 (71)	11 (89)
	16 Oct.	4,660	29-130	90 (58)	10 (92)
	21 Nov.	1,703	30-195	71 (72)	29 (148)
	19 Dec.	1,344	38-168	95 (68)	5 (165)
	07 April 77	754	32-111	95 (50)	5 (103)
	02 June	683	30-400	88 (69)	12 (63)
	05 July	1,225	35-126	40 (60)	60 (79)

TABLE 3. Percent composition analysis of substrate from Diamond Creek stations determined from dried seliment weights.

Particle size (mm)	Station 1		Station 2		Station 2	
	Pool	Riffle	Pool	Riffle	Pool	Riffle
<0.5	0.1	0.02	82.6	3.9	4.2	6.3
0.5-3.36	0.1	0.06	0.1	0.7	0.5	3.8
1.0-3.36	0.4	0.6	0.2	12.2	3.0	14.2
3.36-5.6	0.3	1.5	2.7	5.9	3.8	7.2
5.6-8.0	0.3	0.5	4.3	6.2	4.6	7.2
>8.0	98.4	97.2	10.0	71.2	84.3	61.2

(82.6 percent). Riffle areas from Stations 2 and 3 also contained considerable percentages of small sized particles (less than 3.36 mm diameter) ranging from 12.2 to 14.2 percent (Table 3).

Results

Population estimates and size regimes of cutthroat and brook trout from Diamond, Kendall, and Spring creeks are presented in Tables 1 and 2. The greatest number of trout was found in Spring and Kendall creeks, with estimates reaching 4780 and 2264 fish/km. Spring Creek consistently had over 1000 fish/km, and Kendall Creek also had high population densities. Diamond Creek displayed symptoms of overgrazing, since only the September samples were greater than 1000 fish/km at Station 2. Station 3 never reached 1000 fish/km and twice did not provide any fish. Station 1, located above the cattle grazing area, contained greater than 1000 fish/km in over 40 percent of the sampilng periods (Table 1) and contained over 1400 fish/km in November.

Cutthroat trout densities were considerably greater than brook trout densities. Tables 1 and 2 show that brook trout were more common than cutthroat trout only at Station 2 in April, when only one fish was captured, and in July at Spring Creek when 60 percent of the fish caught were brook trout.

The combined size range of cutthroat and brook trout was 20-470 mm. The largest cutthroat trout re ached 470 mm, while brook trout reached 270 mm in length.

Reproduction of cutthroat trout was observed in June and July of 1977. The occurrence of the spawning run was substantiated by the high maximum standard length values of fish from Diamond, Kendall, and Spring creeks in June (Tables 1 and 2). Mean standard length values for brook trout were greatest in November and December, corresponding to the spawning of brook trout during that time. All three creeks were used extensively for spawning sites by both species.

Discussion

This study attempted to ascertain the use of Spring, Kendall, and Diamond creeks, Idaho, as spawning grounds and rearing areas for cutthroat and brook trout. Determination of spawning grounds and rearing areas is important if management practices are to be effective in preserving the naturally reproducing, self-sustaining populations of trout for angling. The use of streams as spawning and rearing areas by lake dwelling salmonids is not uncommon. Raleigh (1969) and Raleigh and Chapman (1971) indicated cutthroat fry move from natal gravel to rearing areas in Yellowstone Lake tributaries. Brannon (1967) and Raleigh (1967) documented similar findings for sockeye salmon. The

cutthroat trout population at Diamond, Kendall, and Spring creeks consists of juvenile fish. The large number of fish with low mean standard length values (Tables 1 and 2) supports the belief that these streams are being used as rearing areas. Also, large adult cutthroat trout occur only during the spawning season of June and July in Diamond, Kendall, and Spring creeks. The presence of spawning cutthroat trout in Diamond, Kendall, and Spring creeks was established and is represented in Tables 1 and 2 by the occurrance of unusually large fish in June and July. Similarly, brook trout were observed spawning in November 1976. Thus, all three streams are used as spawning grounds and rearing areas for both species.

Spring and Kendall creeks appear to support larger populations of trout than Diamond Creek (Tables 1 and 2), although they flow a considerably shorter distance.

Diamond Creek (Station 1) did have high trout densities during September, November, and July, although not as great as Kendall and Spring creeks. However, Stations 2 and 3 on Diamond Creek supported small numbers of trout, and at times Station 3 was devoid of fish (Table 1). The area in which Stations 2 and 3 were located was affected by cattle grazing. The banks were eroded and the stream beds were laden with silt (Table 3). Phillips *et al.* (1975) documented a 20-50 percent decrease in survival of trout fry with the introduction of sediment 1-3 mm in diameter. Station 2 had over 82 percent of the sediment in pool areas within this size range and nearly 16 percent in the riffle areas. Similarly, Station 3 had over 7 percent and 24 percent silt less than 3.66mm in the pool and riffle areas, respectively (Table 3). The presence of heavy siltation probably rendered this portion of Diamond Creek unsuitable for spawning activities. Spawning trout were observed passing through Stations 2 and 3 during June and July 1977, but no redds were located in these areas. The bank erosion and siltation also reduced bank cover at Stations 2 and 3, probably explaining the occurrence of low trout densities at these sites. Hale (1952) and Hunt (1971) indicated that reduced stream cover does correspond to lower trout densities. Thus, Lower Diamond Creek is not only unsuitable as spawning grounds but also as rearing areas for cutthroat and brook trout.

The dominant trout species in the Diamond Creek area is *Salmo clarki* (Tables 1 and 2). Brook trout outnumbered cutthroat trout only in July at Spring Creek and in April at Station 2 of Diamond Creek. The latter site had only one fish collected at that time. Tables 1 and 2 illustrate that the percent species composition of cutthroat and brook trout remained similar throughout the year. Benkhe and Zarn (1976) discussed the displacement of cutthroat trout by brook trout in aquatic systems that underwent habitat degradation. The cutthroat trout population in the Diamond Creek area does not appear to be threatened by competition with brook trout, although if severe habitat degradation occurred in all three streams, the cutthroat trout population might be replaced by brook trout. Prevention of further stream degradation and installation of stream improvement structures on Diamond Creek would not only ensure the future of cutthroat trout spawning grounds and rearing areas but would also increase the available stream habitat in which spawning and rearing could occur successfully.

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Literature Cited

Benkhe, R. J., and M. Zarn. 1976. Biology and Management of Threatened and Endangered Western Trout. USDA Forest Service General Tech. Rep. RM-28.

Benson, N. G. 1960. Factors influencing production of immature cutthroat trout in Arnica Creek, Yellowstone Park. Trans. Amer. Fish Soc. 89(2): 168-175.

Brannon, E. L. 1967. Genetic Control of Migration Behavior of Newly Emerged Sockeye Salmon Fry. Int. Pac. Salmon Fish. Comm. Progr. Rep. 16.

Carlander, K. D. 1969. Handbook of Freshwater Fishery Biology. Vol. 1, 3rd ed., Iowa State Univ. Press, Ames, Iowa.

Carle, F. L., and M. R. Strub. 1978. A new method for estimating population size from removal data. Biometrics 34: 621-630.

Cope, O. B. 1957. Races of cutthroat trout in Yellowstone Lake. US Fish and Wildlife Service Spec. Sci. Rep. Fish No. 208.

Hale, J. G. 1952. An evaluation of trout stream habitat impovements in a north shore tributary of Lake Superior, Minn. Fish Invest. Rep. No. 296: 37-49.

Hunt, R. L. 1971. Responses of a Brook Trout Population to Habitat Development in Lawrence Creek. Tech. Bull. No. 48, Dept. of Nat. Resour., Madison, Wisc.

Libosvarsky, J. 1966. Successive removals with electrofishing gear—a suitable method for making population estimates in small streams. Verh. Int. Ver. Limnol. 16: 1212-1216.

Phillips, R. W., R. L. Lantz, E. W. Claire, and J. W. Moring. 1975. Some effects of gravel mixtures on emergence of coho salmon and steelhead trout fry. Trans. Amer. Fish. Soc. 104(3): 461-466.

Raleigh, R. F. 1967. Genetic control in lakeward migrations sockeye salmonid (*Oncorhynchus nerka*). J. Fish Res. Bd. Can. 24: 2613-2622.

———. 1969. Genetic control in lakeward migrations of salmonid and trout fry from natal gravel to rearing areas. Ecology 52(2): 291-297.

———, and D. W. Chapman. 1971. Genetic control in lakeward migrations of cutthroat trout. Trans. Amer. Fish. Soc. 100: 33-40.

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