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Response of Cutthroat Trout Populations to the Cessation of Fishing in St. Joe River Tributaries

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Idaho Cooperative Fishery Research Unit

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St. Joe River Cutthroat Trout and Northern Squawfish Studies

A FEDERAL AID TO FISH AND WILDLIFE RESTORATION PROJECT

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ABSTRACT

In 1973 the Idaho Fish and Game Commission closed four tributaries of the lower St. Joe River (Reeds, Bond, Trout, and Mica creeks) to angling. To evaluate the effects of the closures on populations of westslope cutthroat trout (*Salmo clarki lewisi*) in tributaries and the St. Joe River, we assessed their species composition, abundance, and movements in the closed tributaries, in tributaries open to angling, and in tributaries with "trophy-fish" regulations, from 1973 to 1977. We also censused anglers on a tributary open to angling to assess angler effort, catch and opinions regarding the fishery.

The closure to angling resulted in larger numbers of both large and small cutthroat trout in the closed tributaries. In the control streams (those open to angling and those with trophy-fish regulations) the abundance of cutthroat trout did not increase significantly during the study period. The increased abundance of trout in the closed streams was the result of increased survival. Angler harvest was a critical factor limiting the density of cutthroat trout in accessible stream sections.

Numerous cutthroat trout in tributaries had limited home ranges and remained in their natal streams. We tagged and released more than 6,200 salmonids (mostly cutthroat trout) in tributaries of the St. Joe River in 1973, 1974, and 1975. We recovered 698 of 6,211 tagged cutthroat trout, of which 619 (89% of the total recovered) were recaptured from the same tributary in which they were released.

Tributaries also contained migratory cutthroat trout which matured in the St. Joe River or Coeur d'Alene Lake. Seventy-nine of the tagged cutthroat trout recovered had been tagged in tributaries and migrated downstream to the St. Joe River. Progeny of the migratory stock remained in tributary streams for 1 or 2 years before migrating in the spring into the St. Joe River or Coeur d'Alene Lake.

We believe that trout which migrated from tributaries to the St. Joe River were the progeny of lake or river trout that spawned in the lower portions of the tributaries. The closure of tributaries to angling increased the abundance of trout in lower, accessible, sections of the tributaries. Since the migratory cutthroat trout we observed were present primarily in the lower sections of tributaries, the closure to angling probably increased the abundance of migratory fish which would eventually enter the St. Joe River. The abundance of cutthroat trout also increased in upper, inaccessible, sections of the closed streams, but few migrated to the St. Joe River from these sections.

Anglers made an estimated 1,015 angling trips and creeled 1,346 cutthroat trout in Big Creek during the 1974 angling season. The catch rate averaged 1.32 cutthroat per angler day, and 53 percent of the angling trips were successful. Cutthroat trout 150-220 mm (6-9 inches) in length constituted 68 percent of the total number harvested. Only 5 percent of the creeled trout were shorter than 150 mm (6 inches). Of the 207 anglers censused, 14 percent caught and kept 5 or more fish and only 2 percent kept a legal limit of 10 fish. Most Big Creek anglers favored some type of restrictive regulations or supplemental stocking to improve angling success or quality in Big Creek. A majority of the anglers would support restrictive regulations on tributary streams to improve the fishery in the main river.

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INTRODUCTION

The abundance of cutthroat trout in the St. Joe River declined during the 1950s and 1960s. Rankel (1971) attributed the reduced abundance and size to overfishing. Studies, beginning in 1969, have been designed to assess the status of the fish stocks, evaluate management programs, and gather additional life history information (Athearn 1973, Bjornn and Thurow 1974, Mauser 1972, Rankel 1971, Thurow and Bjornn 1975).

Starting in 1973, the Idaho Fish and Game Commission closed four tributaries of the lower St. Joe River (Reeds, Bond, Trout, and Mica creeks) to angling. Local sportsmen had requested the closures to increase trout abundance in the St. Joe River. We began studies in 1973, with the primary objective of determining if closure to angling would increase cutthroat trout abundance in these tributary streams and eventually in the St. Joe River through increased downstream migration of fish from the tributaries. We also sought to monitor migration patterns of cutthroat trout in the St. Joe River drainage, to determine angler effort and catch on a tributary of the St. Joe River open to angling, and to assess opinions of anglers regarding the fishery in tributary streams.

This report is based largely on a Master's thesis, "The Effects of Closure to Angling on Cutthroat Trout Populations in Tributaries of the St. Joe River, Idaho," completed by Russell F. Thurow in 1976 at the University of Idaho. Professor Ted C. Bjornn is Idaho Cooperative Fishery Research Unit Leader.

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DESCRIPTION OF STUDY AREA

The St. Joe River originates in the Bitterroot Mountains near the Idaho-Montana border and flows northwest 220 km through the St. Joe National Forest before entering the southern tip of Coeur d'Alene Lake (Fig. 1). The watershed encompasses 57,900 hectares in northern Idaho.

Davis (1961), and Calkin and Jones (1911) described the drainage in detail. Sedimentary rock (Algonkian or pre-Cambrian) underlies the upper drainage. The upper river flows through forest-covered mountains and steep narrow canyons and is characterized by long shallow riffles and deep pools. Sedimentary rock of Quaternary fluviatite and glacial deposits form wide valleys and meadows in the lower drainage. The lower river has a wider channel, deeper pools, and a lesser gradient than the upper river. Slack water, formed by Post Falls Dam, extends 41.8 km up the St. Joe River from Coeur d'Alene Lake and is up to 18.3 m deep. Bottom substrates range from bedrock, gravel, or coarse silt-sand in the upper river to a well scoured clay and mulch bottom in the slack water area (Falter 1969). The entire drainage drops in elevation from 2,318 m at the headwaters, to 671 m at the confluence with Coeur d'Alene Lake.

Peak stream flows occur in May and June as a result of melting snowpack. Flows decrease throughout the summer and increase with the onset of fall-winter precipitation. In 1974 the mean daily flow recorded at Calder was 10,320 cfs in May and 818 cfs in September (U.S. Geological Survey 1974).

The St. Joe River has more than 40 primary tributaries, including the North Fork of the St. Joe River, which enters near Avery, and the St. Maries River, which enters at St. Maries.

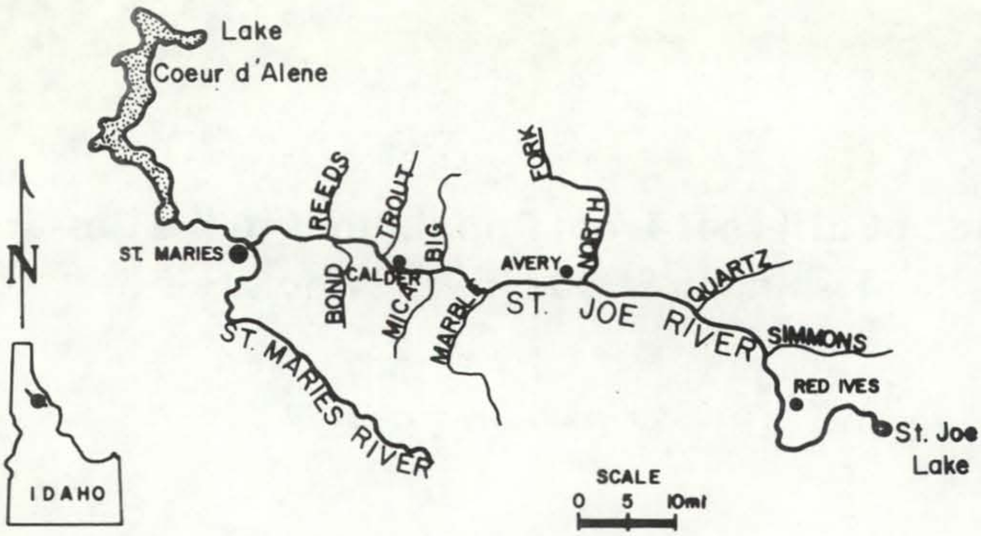


Fig. 1. St. Joe River drainage, Idaho, and location of study streams.

METHODS

Location and Description of Sampling Sites

Initially, we surveyed each of the four tributaries closed to angling in 1973 (Reeds, Bond, Trout, and Mica creeks), and separated them into sections based primarily on physical characteristics and accessibility (Figs. 1 and 2). Within each section we located and marked five transects of similar length at sites we considered good cutthroat trout habitat (pools or deep runs with large fish-holding capacities).

We selected four control streams and set up transects as in the closed tributaries. We selected two control streams (Big and Marble creeks) which were open to angling in the lower portion of the drainage, and two control streams (Quartz and Simmons creeks) with "trophy-fish" regulations (a creel limit of three fish and a minimum legal length of 330 mm) in the upper portion of the drainage.

We measured the physical dimensions of each snorkeling transect in 1973, 1974, and 1975 including: total length, width, and maximum depth at 6-foot intervals (Table 1). We photographed each transect to ensure that we could return to the identical areas in 1974 and 1975. We recorded substrate, pool characteristics, permanent bank cover, and accessibility for each study stream section (Table 2).

Recorded summer discharges ranged from 11 to 40 cfs in the eight study streams (Table 1). Flows remained stable during the summer sample periods. Considerable annual variation in streamflow occurred, with peak discharge in May and June and minimum flows in late August or September. Averett (1963) reported April streamflows in Mica Creek which were 20 times the flows recorded in September. We recorded higher maximum stream temperatures in lower river tributaries (Reeds, Bond, Trout, Mica, and Big) than in upper river tributaries (Table 1).

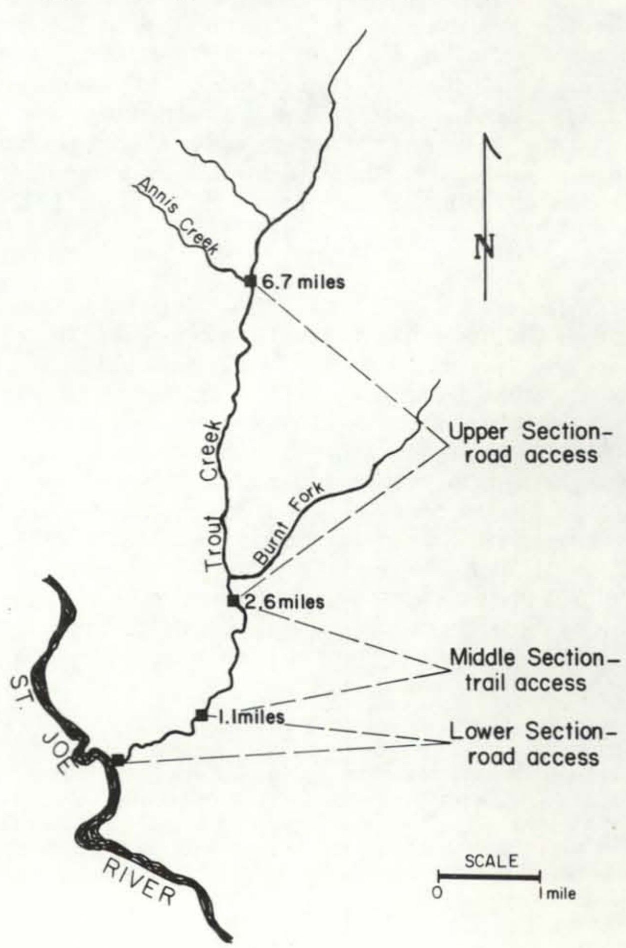


Fig. 2. Trout Creek and locations of sampling sections.

Table 1. Physical characteristics and mean dimensions of snorkeling transects in each study stream section. Mean of five transects.

Fishing regulations and stream	Section	Approximate date surveyed	Summer[a] flow (cfs)	Temp. °C		Transect measurement (in feet), 1973					Transect measurement (in feet), 1974					Transect measurement (in feet), 1975				
				Max.	Min.	Length	Width	Surface area	Thalweg depth	Volume[b]	Length	Width	Surface area	Thalweg depth	Volume[b]	Length	Width	Surface area	Thalweg depth	Volume[b]
Closed to fishing																				
Reeds Creek	Lower	July 30	15.0	17.0	12.0	26.4	12.1	319.4	1.2	287.5	26.8	11.6	310.9	1.4	342.0	24.2	11.8	285.6	1.4	299.9
	Upper	July 30	–	15.0	12.0	25.0	19.0	475.0	1.8	665.0	25.0	18.3	457.5	2.0	685.8	25.0	17.6	440.0	2.2	726.0
Bond Creek	Lower	Aug. 1	13.8	21.0	17.0	61.4	15.6	957.8	1.5	1053.6	72.4	18.0	1303.2	1.7	1694.2	67.8	18.2	1234.0	1.9	1758.5
	Middle	Aug. 6	–	19.0	14.0	41.2	13.4	552.1	1.5	607.3	43.6	13.5	588.6	2.0	882.9	52.8	14.8	781.4	2.0	1172.1
	Upper	Aug. 5	–	18.0	14.0	60.6	13.8	836.8	1.4	920.5	63.8	14.2	906.0	1.5	996.6	50.8	14.2	721.4	1.4	757.5
Trout Creek	Lower	Aug. 7	10.6	17.5	12.0	102.2	19.0	1941.8	1.6	2330.2	95.6	21.1	2017.2	1.7	2622.4	100.8	19.7	1985.8	1.7	2531.9
	Middle	Aug. 8	–	15.0	11.0	58.2	18.3	1065.1	2.4	1917.2	64.0	18.5	1184.0	2.3	2012.8	56.4	17.4	981.4	2.5	1840.1
	Upper	Aug. 9	–	13.0	11.0	34.8	16.8	584.6	1.5	643.1	47.2	18.7	882.6	1.4	970.9	44.0	17.5	770.0	1.4	808.5
Mica Creek	Lower	Aug. 12	26.1	15.5	10.0	83.0	21.1	1751.3	1.9	2451.8	72.2	24.6	1776.1	1.9	2486.5	72.4	22.7	1643.5	1.9	2342.0
	Middle	Aug. 17	–	14.0	10.0	89.0	25.8	2296.2	2.5	4362.8	92.0	27.5	2530.0	2.7	5060.0	92.4	26.4	2439.4	2.8	5122.7
	Upper	Aug. 13	–	13.0	8.5	57.6	19.2	1105.9	1.5	1216.5	80.2	16.4	1315.3	1.5	1446.8	77.4	16.7	1292.6	1.5	1454.2
Open to fishing																				
Big Creek	Lower	Aug. 14	33.8	16.0	11.0	138.2	31.7	4380.9	2.2	7447.5	155.4	33.2	5159.3	2.5	9802.7	157.8	31.0	4891.8	2.4	8805.2
	Middle	Aug. 14	–	15.0	9.0	97.0	26.4	2560.8	2.8	5377.7	72.2	23.7	1711.1	3.1	3935.5	69.0	23.0	1587.0	3.3	3927.8
	Upper	Aug. 15	–	14.0	12.5	61.0	19.9	1213.9	1.8	1699.5	70.8	19.5	1380.6	1.9	1932.8	71.6	19.6	1403.4	1.8	1894.6
Marble Creek	Lower	Aug. 19	–	13.5	10.5	169.4	46.9	7944.9	3.9	23040.2	159.8	42.4	6775.5	4.4	22359.2	149.2	41.8	6236.6	2.2	1759.9
	Upper	Aug. 20	–	12.0	7.0	99.9	26.6	2638.7	2.8	5541.3	114.2	31.5	3597.3	3.2	8633.5	102.4	31.4	3215.4	3.4	891.0
Trophy-fish regulations																				
Quartz Creek	Lower	Aug. 22	12.8	11.0	9.0	56.0	18.8	1052.8	2.0	1579.2	60.2	20.5	1234.1	2.2	1974.6	53.6	19.9	1066.6	2.2	1759.9
	Upper	Aug. 23	–	10.0	7.5	49.4	18.3	904.0	2.1	1446.4	58.4	16.7	975.3	2.1	1560.5	39.6	15.0	549.0	2.0	891.0
Simmons Creek	Lower	Aug. 29	41.3	15.5	9.0	86.2	29.0	2499.8	1.7	3249.7	84.2	29.6	2492.3	1.6	2990.8	79.6	30.0	2388.0	1.9	3402.9
	Upper	Aug. 30	–	15.5	9.0	52.0	24.9	1294.8	2.5	2460.1	51.2	23.3	1193.0	2.4	2147.4	53.0	24.7	1309.1	2.7	2650.9

[a] Flow data collected by Mauser (1970) during July and August, 1969.

[b] Volume of pool equal to surface area x ¾ thalweg depth.

Table 2. Physical characteristics of streams in vicinity of study sections.

Stream	Section	River miles from creek mouth	General stream characteristics: Substrate	Pool characteristics	Bank cover	Accessibility and condition
Reeds Creek	Lower	0.9	gravel	small pools	conifer canopy sparse brush	access by road moderate grazing
	Upper	1.5	gravel-rubble	numerous pools	conifer canopy sparse brush	no access road or trail
Bond Creek	Lower	2.0	clay-silt	pools as long runs	open pasture, sparse brush	heavy grazing, bank erosion, access by road
	Middle	3.3	silt-gravel basalt rubble	shallow pools, overhanging logs	slight forest canopy, primarily brush	moderate grazing, no access road or trail
	Upper	4.5	silt-gravel basalt rubble	shallow pools	slight conifer canopy, primarily brush	some logging activity (access by road)
Trout Creek	Lower	0.6	gravel-rubble	large pools	sparse forest canopy	moderate grazing, access by road
	Middle	2.0	rubble-large boulder	numerous deep pools in steep rocky gorge	sparse forest canopy	no access road, trail to lower end
	Upper	5.6	sand-gravel	numerous small pools, overhanging logs	slight forest canopy, primarily brush	rough access road
Mica Creek	Lower	0.6	gravel-rubble	numerous large pools, rock ledges along pools	primarily brush	access by road
	Middle	3.0	gravel-rubble boulder	numerous deep pools in steep rocky gorge	sparse forest canopy	no road access, long, steep trail
	Upper	7.8	silt-sand gravel	pools as long runs in wide meadow	primarily brush interspersed with grasses and sedges	access by road moderate grazing
Big Creek	Lower	1.8	gravel-rubble	numerous large pools, rock ledges along pools	primarily brush	access road parallels stream
	Middle	5.0	gravel-rubble	numerous large pools, rock ledges along pools	primarily brush	access road parallels stream
	Upper	9.8	gravel-rubble boulder	numerous pools, rock outcrops present	primarily brush, some forest canopy	access by trail
Marble Creek	Lower	5.4	gravel-rubble boulder	pools sparse and very large	sparse forest canopy	access road parallels stream
	Upper	13.3	gravel-rubble boulder	numerous pools, rock ledges along pools	primarily brush, some forest canopy	access by road, trail to upper end
Quartz Creek	Lower	0.5	gravel-rubble boulder	numerous pools, overhanging logs	sparse forest canopy	access road parallels stream
	Upper	2.0	gravel-rubble boulder	numerous pools, overhanging logs	primarily brush, sparse forest canopy	access road parallels stream
Simmons Creek	Lower	0.5	gravel-rubble boulder	few pools, pools at long runs	primarily brush	access by road or trail
	Upper	2.5	gravel-rubble boulder	numerous pools, overhanging logs	primarily brush	access by trail

Within the upper sections of each study stream we observed steeper stream gradients, lower maximum water temperatures, more gravel-sand substrate, and more pools than in the lower sections. The middle or upper section of each study stream was usually accessible to anglers by footpath only.

Streamside cover consisted of sparse forest canopy and brush. Cattle grazing occurred along only four stream sections. The streams were generally undisturbed by agricultural or logging activity, and even during peak discharge turbidity was not excessive (except in Bond Creek).

Cutthroat trout lived in all sections of the study streams (Table 3). Brook trout were abundant in the lower or meadow sections of the lower river tributaries. Idaho Department of Fish and Game employees stocked catchable-sized rainbow trout, *Salmo gairdneri*, 20 cm long or longer, in Big Creek in 1973 and 1975 and in Marble Creek in 1973-1975. We also observed a few wild rainbow trout in Mica, Big, and Simmons creeks. Dolly Varden, *Salvelinus malma*, were not abundant; we observed two in Mica Creek and one in Simmons Creek in 1974. Kokanee, *Oncorhynchus nerka* entered the lower section of Trout Creek to spawn in November 1974. Other species present in the tributaries included mountain whitefish, *Prosopium williamsoni* in Bond and Marble creeks and four others in Bond Creek: northern squawfish, *Ptychocheilus oregonensis*; redside shiners, *Richardsonius balteatus*; speckled dace, *Rhinichthys osculus*; and longnose dace, *Rhinichthys cataractae*. Sculpins, *Cottus* sp., were abundant in all sections of the study streams.

Abundance of Fish

To evaluate the effects of closure to angling on tributary populations of cutthroat trout, we counted fish in established transects in each of the eight study streams in 1973, 1974 and 1975. Using a wet suit and snorkle, we counted the total number of fish per transect (by species) and grouped the fish into 50-mm length groups. After completing counts of age I and older fish, we crawled along the edges of the transects and counted all young-of-the-year trout. We counted fish in the transects once each year on about the same date during mid to late summer, when little movement of cutthroat trout occurs (Ball 1971, Rankel 1971).

Size Structure of Trout Populations

To compare length frequency distributions of cutthroat trout collected by angling, we recorded the total length (in millimeters) of each trout (tagged and untagged) captured by project personnel throughout the summer. Length shall be understood as total length throughout this paper.

Cutthroat Trout Movements

To assess movement of cutthroat trout and to determine which tributaries contributed fish to the river fishery, we captured and tagged 6,211 cutthroat trout in the St. Joe River or its tributaries, together with 437 other salmonids (total 6,648) in 1973, 1974, and 1975 (Table 4). Most were tagged in the eight study streams. A smaller number were tagged in other tributaries throughout the drainage, and 427 salmonids were captured in the St. Joe River. We tagged most of the trout from June through October, when they would be readily caught. We used barbless flies and lures to capture the fish, then attached numbered monel-metal tags to the mandible of all wild trout longer than 130 mm before releasing them at the capture site. Species, total length, tag number, date and location of capture were recorded for each fish tagged and released.

To obtain tag returns and recapture information, we fished the St. Joe River and the tributaries where we had previously tagged fish. Project personnel caught most of the tagged trout retaken in tributaries, and anglers caught nearly all the tagged cutthroat trout recaptured in the St. Joe River. The information channel used to contact anglers in 1973 was the release to local newspapers; we obtained nine usable tag returns that year. In 1974 and 1975, the following methods were added: we posted informational signs along the St. Joe River, explaining the project; placed tag deposit boxes locally; and announced prize drawings for anglers returning tags. Postal cards giving a brief history of the fish caught were sent to each person who returned a tag. Anglers returned 63 tags with usable information in 1974 and 64 in 1975. Although more tagged cutthroat trout were present in 1974 and 1975 than in 1973, the signs and lottery apparently stimulated anglers to return tags. Project personnel were not present on the St. Joe River to contact anglers in 1976 and 1977; however, anglers returned information on an additional 27 tagged fish.

Seasonal Migration

To assess downstream movement of cutthroat trout, we constructed a weir in the lower St. Joe River (hereafter referred to as the Big Eddy weir), 90 m downstream from the mouth of Trout Creek, in fall 1973. All fish captured in the weir were recorded and all trout were tagged before they were released.

We constructed a weir in Trout Creek 180 m upstream from the St. Joe River in 1974, and in Bond Creek 550 m upstream from the St. Joe River in 1975 to monitor downstream movement of cutthroat trout in tributaries. We constructed a weir in Fire Creek Draw (tributary to Bond Creek) in 1975 to monitor downstream movement of cutthroat trout fry into Bond Creek.

Maturity of Cutthroat Trout

We collected cutthroat trout by angling from sections of the lower river tributaries in September 1975 to determine the size at which the trout mature in tributaries and to ascertain whether those in upper and lower stream sections mature at different sizes. We dissected 27 cutthroat

Table 3. Mean numbers of fish counted per transect in each study stream section, 1973, 1974, and 1975.

			Fish/transect by size groups (mm) – 1973							
Stream	Section	Species[a]	Fry	< 100	100-150	151-200	201-250	251-300	> 300	Total w/o fry
Closed to fishing										
Reeds Creek	Lower	CT	4.2	–	2.0	2.4	0.4	–	–	4.8
		BK	3.8	–	1.0	1.6	0.8	0.2	–	3.6
	Upper	CT	6.4	–	2.4	6.6	3.6	–	–	12.6
		BK	–	–	–	0.2	–	0.2	–	0.4
Bond Creek	Lower	CT	5.0	–	3.8	4.8	1.2	–	–	9.8
		BK	–	–	–	1.0	0.8	0.2	–	2.0
	Middle	CT	6.8	–	3.4	7.2	1.4	–	–	12.0
		BK	–	–	–	–	0.2	0.2	0.2	0.6
	Upper	CT	6.4	–	5.0	4.0	1.0	–	–	10.0
Trout Creek	Lower	CT	9.4	–	1.8	3.6	0.8	–	0.2	6.4
		BK	0.2	–	0.2	0.6	–	–	–	0.8
	Middle	CT	8.4	2.6	4.6	5.6	1.8	0.2	0.2	15.0
	Upper	CT	11.0	7.2	11.4	7.8	1.0	–	0.6	28.0
Mica Creek	Lower	CT	3.8	–	1.4	2.2	0.6	0.2	–	4.4
		BK	–	0.2	0.2	0.6	–	–	–	1.0
		A-Rb	–	–	–	–	0.8	–	–	0.8
	Middle	CT	15.2	–	1.4	2.4	1.0	0.6	1.2	6.6
		BK	–	–	–	–	0.4	–	0.2	0.6
	Upper	CT	0.6	–	1.2	1.8	0.6	–	–	3.6
		BK	15.0	–	5.4	6.2	1.4	0.6	0.4	14.0
Open to fishing										
Big Creek	Lower	CT	0.2	0.2	0.6	1.8	0.4	–	–	3.0
		BK	0.2	–	–	0.2	–	–	–	0.2
		H-Rb	–	–	–	9.4	6.8	0.2	–	16.4
	Middle	CT	5.6	–	2.8	4.4	0.8	–	–	8.0
		H-Rb	–	–	–	4.4	2.6	–	–	7.0
	Upper	CT	15.8	4.4	9.0	8.6	2.2	0.4	–	24.6
Marble Creek	Lower	CT	–	–	0.4	1.2	1.0	0.2	–	2.8
		H-Rb	–	–	–	5.8	6.2	–	–	12.0
	Upper	CT	0.4	–	1.6	4.8	2.4	0.8	–	9.6
Trophy-fish regulations										
Quartz Creek	Lower	CT	9.8	4.0	3.0	4.4	3.0	0.6	–	15.0
	Upper	CT	8.8	4.2	3.2	4.4	2.8	–	–	14.6
Simmons Creek	Lower	CT	–	2.2	2.8	4.4	4.0	1.6	0.2	13.0
	Upper	CT	3.4	–	1.2	5.4	5.0	2.2	1.0	14.8
		Rb	–	–	–	–	–	0.2	–	0.2

[a] Abbreviations: CT – cutthroat trout, BK – brook trout, Rb – rainbow trout, H-Rb – hatchery rainbow, A-Rb – adipose clip rainbow, DV – Dolly varden

Table 3. (Continued)

Stream	Section	Species	Fish/transect by size groups (mm) – 1974							
			Fry	<100	100-150	151-200	201-250	251-300	> 300	Total w/o fry
Closed to fishing										
Reeds Creek	Lower	CT	0.8	2.8	2.6	1.8	1.2	–	–	8.4
		BK	–	–	0.6	1.2	0.8	0.6	0.2	3.4
	Upper	CT	2.0	1.4	2.4	5.2	4.2	0.2	–	13.4
		BK	–	–	–	0.2	–	0.2	–	0.4
Bond Creek	Lower	CT	5.4	–	3.4	3.4	0.8	–	–	7.6
		BK	–	–	0.2	1.2	1.0	0.6	0.4	3.4
	Middle	CT	6.2	0.8	4.8	4.8	1.8	0.2	–	12.4
		BK	–	0.2	0.4	0.4	0.4	0.6	0.2	2.2
	Upper	CT	19.0	0.6	4.6	3.4	1.6	0.2	–	10.4
		BK	–	–	–	–	–	0.2	–	0.2
Trout Creek	Lower	CT	21.2	1.4	5.6	4.8	1.4	0.4	–	13.6
		BK	–	–	–	0.2	–	0.2	–	0.4
	Middle	CT	24.6	–	3.2	5.0	3.0	1.2	0.8	13.2
		BK	–	–	0.2	–	–	–	–	0.2
	Upper	CT	44.6	12.8	18.4	13.0	3.0	0.4	0.4	48.0
Mica Creek	Lower	CT	4.0	–	2.0	4.0	0.8	0.8	–	7.6
		BK	–	–	–	–	–	0.2	0.2	0.4
	Middle	CT	31.8	–	2.2	4.0	1.6	1.0	1.2	10.0
		BK	0.2	–	–	0.2	–	–	–	0.2
		DV	–	–	–	–	0.2	0.2	–	0.4
		A-Rb	–	–	–	–	–	–	0.2	0.2
	Upper	CT	0.4	1.6	2.0	3.0	1.0	–	–	7.6
		BK	14.2	0.6	9.2	8.8	1.8	0.4	0.4	21.2
Open to fishing										
Big Creek	Lower	CT	2.8	–	2.6	5.6	0.6	–	–	8.8
		BK	–	–	0.4	0.4	–	–	–	0.8
		Rb	–	–	–	–	0.6	–	–	0.6
		H-Rb	–	–	–	–	–	0.2	–	0.2
	Middle	CT	2.8	–	4.2	5.8	0.8	–	–	10.8
		Rb	–	–	–	0.2	–	–	–	0.2
		H-Rb	–	–	–	–	–	–	0.2	0.2
	Upper	CT	14.6	0.2	6.2	9.8	2.8	1.0	0.2	20.2
Marble Creek	Lower	CT	–	–	0.2	3.0	0.5	–	–	3.7
		H-Rb	–	–	–	1.0	3.5	0.5	0.2	4.3
	Upper	CT	–	0.2	3.8	8.4	2.0	0.6	0.2	15.2
Trophy-fish regulations										
Quartz Creek	Lower	CT	12.0	2.2	4.0	7.4	3.4	2.0	0.4	19.4
	Upper	CT	6.2	4.0	4.0	6.2	2.2	1.2	–	17.6
Simmons Creek	Lower	CT	2.2	–	5.2	6.6	3.0	2.0	0.4	17.2
	Upper	CT	0.2	–	2.6	3.4	2.2	0.8	0.2	9.2
		DV	–	–	–	0.4	–	–	–	0.4

Table 3. (Continued)

Stream	Section	Species	Fish/transect by size groups (mm) – 1975							
			Fry	< 100	100-150	151-200	201-250	251-300	> 300	Total w/o fry
Closed to fishing										
Reeds Creek	Lower	CT	2.8	0.8	1.6	1.2	1.0	0.4	–	5.0
		BK	–	0.4	1.0	1.0	0.8	0.4	0.2	3.8
	Upper	CT	3.2	1.6	3.4	6.2	2.4	1.0	–	14.6
		BK	–	0.2	0.4	0.4	0.2	0.2	–	1.4
Bond Creek	Lower	CT	4.2	0.4	3.4	3.0	1.2	0.6	0.4	9.0
		BK	1.0	–	–	0.6	1.2	0.8	0.4	3.0
	Middle	CT	8.2	2.4	4.2	3.8	1.0	0.8	0.2	12.4
		BK	0.6	–	–	0.6	–	–	–	0.6
	Upper	CT	11.6	3.4	4.0	2.2	0.4	–	–	10.0
Trout Creek	Lower	CT	7.0	0.4	2.8	1.6	0.6	–	0.2	5.6
		BK	0.2	–	–	–	0.2	–	–	0.2
		A-Rb	–	–	–	–	–	–	0.2	0.2
	Middle	CT	17.4	3.2	9.0	2.8	1.0	0.6	0.4	17.0
		DV	–	–	–	0.2	–	–	–	0.2
	Upper	CT	45.6	17.8	20.2	10.4	2.0	0.8	0.2	51.4
Mica Creek	Lower	CT	5.2	–	4.8	2.4	0.4	0.2	–	7.8
		BK	0.2	–	0.2	0.2	0.2	–	–	0.6
	Middle	CT	23.8	0.6	14.2	7.0	0.4	1.0	0.2	23.4
		BK	–	0.2	0.6	0.4	0.2	–	–	1.4
		DV	–	–	–	–	0.2	–	–	0.2
	Upper	CT	3.6	0.8	0.6	1.8	0.8	0.2	–	4.2
		BK	9.8	1.0	9.4	5.2	3.0	0.8	0.2	19.6
Open to fishing										
Big Creek	Lower	CT	1.0	–	2.2	2.4	0.6	0.2	–	5.4
		BK	–	0.2	–	0.4	–	–	–	0.6
		H-Rb	–	–	–	1.6	3.0	0.2	–	4.8
	Middle	CT	3.2	0.4	5.2	2.4	0.2	–	–	8.2
		H-Rb	–	–	–	2.8	4.6	0.8	–	8.2
	Upper	CT	21.4	0.8	10.2	5.2	1.4	0.4	–	18.0
Marble Creek	Lower	CT	–	–	0.2	1.0	0.2	–	–	1.4
		H-Rb	–	–	–	10.0	57.2	29.7	–	96.9
	Upper	CT	–	–	1.8	5.0	1.4	0.2	–	8.4
Trophy-fish regulations										
Quartz Creek	Lower	CT	3.6	1.0	4.4	4.2	2.2	0.8	–	12.6
	Upper	CT	1.0	0.6	3.6	3.6	1.4	0.2	–	9.4
Simmons Creek	Lower	CT	2.4	–	1.0	5.8	2.6	1.2	0.2	10.8
	Upper	CT	1.8	–	1.6	3.2	3.0	1.0	0.2	9.0
		DV	–	–	–	–	0.2	–	–	0.2

Table 4. Numbers of cutthroat trout and other salmonids tagged and released in the St. Joe River and tributaries during 1969, 1970 and 1973-1975.

Year	Cutthroat trout		Brook trout		Rainbow trout		Dolly Varden		All species		
tagged	River	Tributaries	River	Tributaries	River	Tributaries	River	Tributaries	River	Tributaries	Total
1969	194	706	2	1	95	16	2	7	293	730	1,023
1970	605	7,468	0	0	4	1	0	0	609	7,469	8,078
1973	180	1,612	0	114	21	10	5	2	206	1,738	1,944
1974	34	3,306	0	172	0	27	0	4	34	3,509	3,543
1975	169	910	0	75	4	2	1	0	174	987	1,161
Totals	1,182	14,002	2	362	124	56	8	13	1,316	14,433	15,749

trout collected from lower Bond Creek and 54 from upper Trout Creek. Trout with well-developed gonads were designated as mature (had spawned during the previous spring or would have been expected to spawn during the following spring).

Creel Census

For the 1974 creel census on Big Creek, a tributary of the lower St. Joe River, we divided the fishing season into three intervals as follows: I, 22 June-12 July; II, 13 July-10 August; and III, 11 August-1 September. Within each interval we randomly selected 7 weekdays and 4 weekend days or holidays as census days.

On each census day a clerk stationed at the mouth of Big Creek interviewed all anglers leaving by the single access road, from 0900 hours to darkness, as they completed their fishing trips. The clerk recorded size of party, angler residence, stream section fished, fishing method, catch composition, and catch per angler day. Whenever possible, the clerk measured all creeled fish, by species. After this information was recorded, the clerk asked the anglers to give their opinions on fishing preferences, attitudes about tributary fishing, and acceptable stream management procedures.

We estimated the number of angler days per interval as follows:

$$\text{Angler Days} = \bar{X}D$$

where

$\bar{X}$ = mean number of anglers counted for all weekday or weekend days censused during an interval.

D = number of days (weekday or weekend day) per interval.

Since anglers occasionally camped along Big Creek and fished for two or more days, we asked each angler how many days he had fished (in addition to the day censused) on that trip. We incorporated a correction factor based on the incidence of extra angling days per trip into our estimated angling effort.

$$\text{Additional Days} = \bar{X}'\ D$$

where

$\bar{X}'$ = mean number of extra angling days per weekday or weekend day during an interval.

D = number of days (weekday or weekend day) per interval.

Total estimated angler days per interval were calculated by the addition of the means for censused days and extra days.

where

$$\text{Total Angler Days} = (\bar{X} + \bar{X}')D$$

We estimated the catch by multiplying the estimated total angler days per interval by the mean catch per angler day. The mean catch per angler day was based on the catch recorded on census days only.

RESULTS

CHANGES IN ABUNDANCE OF FISH

Age I and Older Cutthroat Trout

Cutthroat trout increased in abundance in 10 of 11 stream sections that had been closed to angling for 2 years, and in 2 of 7 sections in control streams (open to angling and with trophy-fish regulations) (Table 5). The abundance of cutthroat trout in sections of the closed streams accessible by road increased substantially after 1 year of closure to angling (Table 6). Although trout abundance in the accessible sections decreased from 1974 levels in 1975, we observed significantly more cutthroat trout in 1975 than in 1973. In "inaccessible" sections (accessible only by an

Table 5. Mean numbers of age I and older cutthroat trout counted in snorkeling transects in sections of tributaries open to angling, closed to angling, and with trophy-fish regulations, 1973-1975, and calculated *t* values and probabilities of obtaining larger *t* values.

Stream and type of regulation	Section	Accessible	Cutthroat per transect 1973	1974	1975	Percentage change 1973 to 1975	Degrees of freedom	Calculated *t* values[a]	Probability of larger *t* values
Closed to fishing									
Reeds Creek	Lower	Yes	4.8	8.4	5.0	4.2	4	.1280	>.50
	Upper	No	12.6	13.4	14.6	15.9	4	.8687	<.50
Bond Creek	Lower	Yes	8.6	7.6	9.0	4.7	4	.1495	>.50
	Middle	No	12.2	12.4	12.4	1.6	4	.1078	>.50
	Upper	No	9.7	10.7	10.3	6.2	3	.3780	>.50
Trout Creek	Lower	Yes	6.4	13.6	5.6	-12.5	4	.6447	>.50
	Middle	No	15.2	13.2	17.0	11.8	4	2.0925	<.10
	Upper	Yes	28.0	48.0	51.4	83.6	4	4.7705	<.005
Mica Creek	Lower	Yes	4.4	7.6	7.8	77.3	4	1.0883	<.20
	Middle	No	6.6	10.0	23.4	254.5	4	3.4408	<.025
	Upper	Yes	4.0	7.5	4.5	12.5	1	.3333	>.50
Open to fishing									
Big Creek	Lower	Yes	3.0	8.8	5.4	46.7	4	1.3950	<.20
	Middle	Yes	8.3	9.3	9.7	16.9	3	1.732	<.10
	Upper	No	24.6	20.2	18.0	-26.8	4	1.5039	<.20
Marble Creek	Lower	Yes	3.3	3.7	1.5	-54.5	3	3.6556	<.01
	Upper	No	9.6	15.2	8.4	-12.5	4	1.0000	<.20
Trophy-fish regulations									
Quartz Creek	Lower	Yes	17.0	20.5	13.7	-19.4	3	.9490	<.30
	Upper	Yes	14.6	17.6	9.4	-35.6	4	1.5307	<.20
Simmons Creek	Lower	Yes	15.2	17.2	10.8	-28.9	4	1.4157	<.20
	Upper	No	14.8	9.2	9.0	-39.2	4	2.6095	<.05

[a] A *t*-test for the difference between two means using unpaired sample locations was used in most cases.

Table 6. Mean numbers of age I and older cutthroat trout counted in snorkeling transects from 1973-1975 in tributaries, grouped by angling regulation and accessibility of the sections, and calculated *t* values and probabilities of obtaining larger *t* values.

Angling regulation and accessibility	Mean number trout 1973	1974	1975	Change 1973-1974 Degrees of freedom	Calculated *t* values	Probability of larger *t* values	Change 1973-1975 Degrees of freedom	Calculated *t* values	Probability of larger *t* values
Closed to fishing									
Accessible	9.96	16.33	14.93	26	3.8122*	<.0005	26	2.3853*	<.01
Inaccessible	11.33	11.58	15.75	23	0.2531	>.25	23	2.5409*	<.01
Open to fishing									
Accessible	4.69	7.38	5.54	12	1.8163*	< .05	12	.9999	<.20
Inaccessible	17.10	17.70	13.20	9	0.2300	>.25	9	1.6767	<.10
Trophy-fish regulations									
Accessible	15.50	18.10	11.14	13	1.1200	<.15	13	2.4551*	<.025
Inaccessible	14.80	9.20	9.00	4	2.9680*	<.025	4	2.6095*	<.05

* Denotes significance at 0.05 level.

Table 7. The change in abundance of cutthroat trout counted in snorkeling transects from 1973-1975 in tributaries closed to fishing, open to fishing and with trophy-fish regulations. Abundance is compared as mean numbers of fish per transect, fish per 100 ft^2 of pool surface area and fish per 100 ft^3 of pool volume.

Stream and type of regulation	Section	Accessible	Percentage change 1973 to 1975		
			Fish /transect	Fish /100 ft^2	Fish /100 ft^3
Closed to fishing					
Reeds Creek	Lower	Yes	4.2	16.7	0.0
	Upper	No	15.9	25.3	6.3
Bond Creek	Lower	Yes	8.2	-28.4	-45.2
	Middle	No	3.3	-26.7	-46.5
	Upper	No	0.0	-15.8	21.1
Trout Creek	Lower	Yes	-12.5	-15.1	-18.5
	Middle	No	13.3	22.7	17.9
	Upper	Yes	83.6	39.2	46.2
Mica Creek	Lower	Yes	77.3	88.0	83.3
	Middle	No	254.5	231.0	206.7
	Upper	Yes	16.7	-3.0	-3.3
Open to fishing					
Big Creek	Lower	Yes	46.7	57.1	50.0
	Middle	Yes	2.5	67.7	40.0
	Upper	No	-26.8	-36.9	-34.5
Marble Creek	Lower	Yes	-50.0	-50.0	0.0
	Upper	No	-12.5	-27.8	-44.4
Trophy-fish regulations					
Quartz Creek	Lower	Yes	-16.0	-16.9	-24.2
	Upper	Yes	-35.6	-2.5	-4.0
Simmons Creek	Lower	Yes	-16.9	-13.5	-22.5
	Upper	No	-39.2	-39.5	-43.3

unmaintained road or a trail) of the closed streams, the abundance of trout did not increase significantly in 1974, after 1 year of closure, but we saw more trout in 1975 after 2 years of closure than we saw in 1973 (Table 6).

Trout abundance not only did not increase in the control streams (open to angling and with trophy-fish regulations) from 1973 to 1975, but decreased significantly (Table 6).

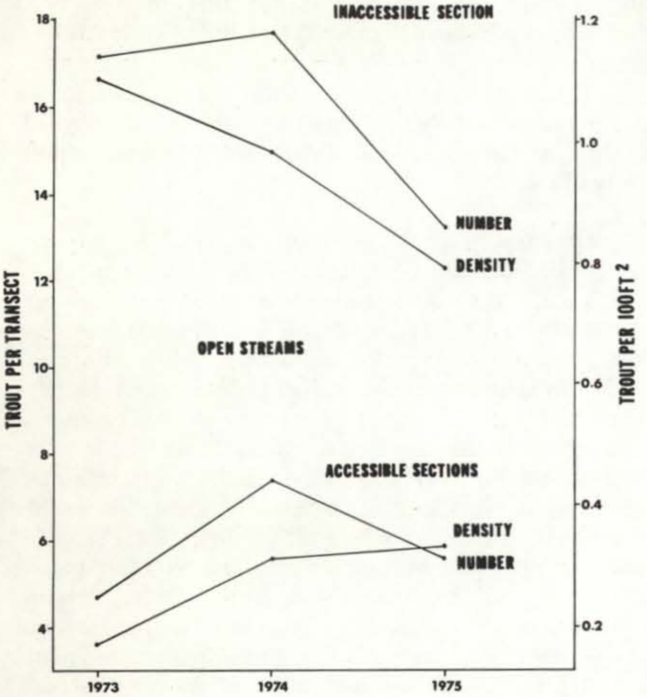
Densities of cutthroat trout (measured as trout per 100 ft^2 of pool surface area) followed the same trends as abundance estimates (measured as trout per transect) from 1973 to 1975 (Tables 7 and 8 and Fig. 3). The densities of cutthroat trout varied considerably in different streams and stream sections, and we believe stream morphometry and water temperature, as well as angling regulations, affected the densities of trout (Table 9). Densities of cutthroat trout were highest in sections of the closed streams, and were similar in accessible and inaccessible areas in 1975, after 3 years of closure to angling (Table 8). Trout densities were also similar in accessible and inaccessible sections of the streams with trophy-fish regulations. In streams open to angling, we saw more trout in inaccessible sections than in accessible ones. Project personnel also captured fewer cutthroat trout in accessible sections of the open streams, as reflected by the small sample size from the lower sections (Table 10).

After 1 year of closure to angling, the abundance of trout 50-150 mm, 151-200 mm, and 201-250 mm long increased significantly in accessible sections (Table 11, Fig. 4). In the inaccessible sections only trout longer than 200 mm increased significantly in abundance. After 2 years of closure, the abundance of trout 50-150 mm long, and longer than 200 mm increased significantly in both accessible and inaccessible sections of the closed streams.

Table 8. Densities (fish/100 ft^2 of pool surface area) of age I and older cutthroat trout counted in snorkeling transects from 1973-1975 in tributaries, grouped by the type of angling regulation and accessibility of the sections and calculated *t* values and probabilities of obtaining larger *t* values.

Type of regulation and accessibility	Mean number trout			Change 1973-1974			Change 1973-1975		
	1973	1974	1975	Degrees of freedom	Calculated *t* values	Probability of larger *t* values	Degrees of freedom	Calculated *t* values	Probability of larger *t* values
Closed to fishing									
Accessible	1.63	1.99	1.91	26	1.9599*	<.05	26	1.1981	<.15
Inaccessible	1.59	1.64	1.89	23	.3504	>.25	23	1.9080*	<.05
Open to fishing									
Accessible	0.17	0.31	0.33	12	1.9691*	<.05	12	1.4891	<.10
Inaccessible	1.15	0.98	0.79	9	1.1783	<.15	9	2.4294*	< .025
Trophy-fish regulations									
Accessible	1.30	1.39	1.04	13	.51111	>.25	13	1.5077	<.10
Inaccessible	1.09	0.99	0.79	4	.3104	>.25	4	1.0098	<.20

*Denotes significance at 0.05 level.



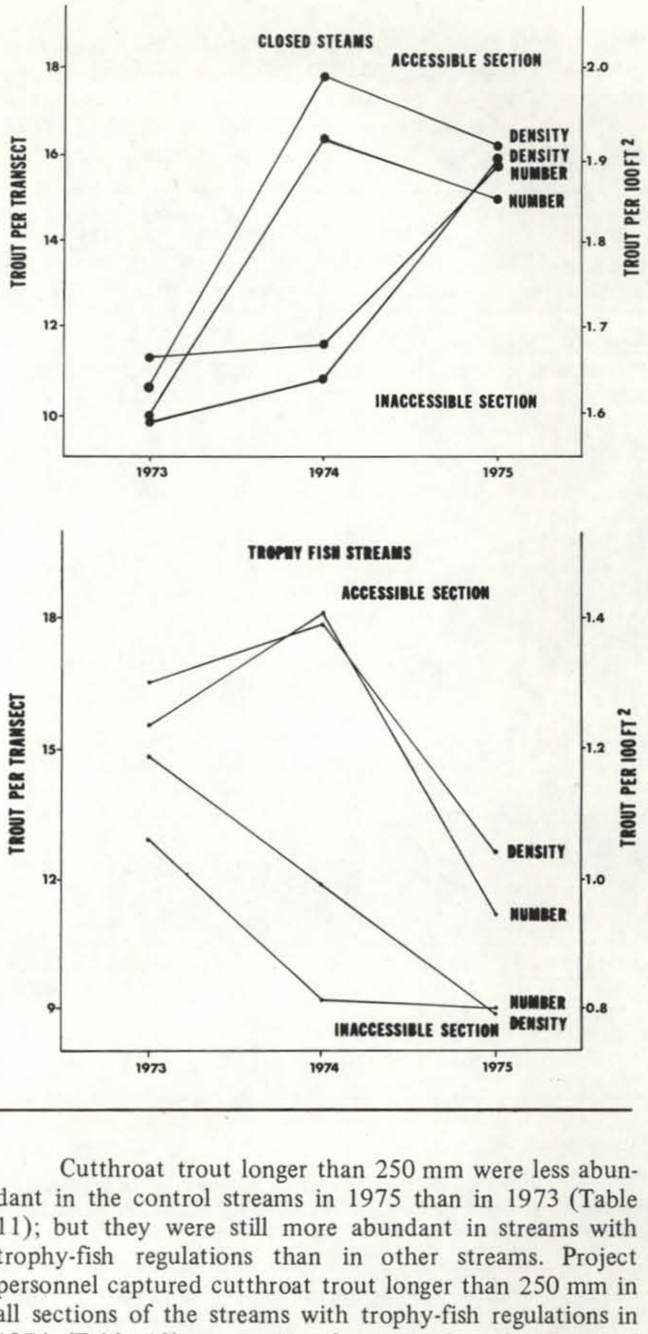


Fig. 3. Change in abundance of cutthroat trout in the closed and open streams and in the streams with trophy-fish regulations measured as mean fish/transect and fish/100 ft^2 of transect surface area, 1973-1975.

In the control streams, the abundance of trout in all size groups did not increase significantly from 1973 to 1975 (Table 11, Fig. 4). We saw significantly more trout 151-200 mm long, and longer than 250 mm, in the control streams in 1974, compared with 1973 sightings, but the abundance of trout in these size groups decreased in 1975. Cutthroat trout 50-150 mm long were the only size group in the accessible sections of the open streams that increased significantly in abundance from 1973 to 1975.

Large cutthroat trout (longer than 250 mm) more than doubled in abundance in the closed streams from 1973 to 1975 (Table 11). Project personnel also captured more large cutthroat in more sections of the closed streams in 1974 than in 1973 (Table 10). We captured large trout in 5 of 10 stream sections in 1973, and in 8 of 10 sections in 1974. In addition, the percentage of trout captured that exceeded 250 mm in length nearly doubled, and the percentage longer than 200 mm increased from 9 to 14 from 1973 to 1974 (Table 12).

Cutthroat trout longer than 250 mm were less abundant in the control streams in 1975 than in 1973 (Table 11); but they were still more abundant in streams with trophy-fish regulations than in other streams. Project personnel captured cutthroat trout longer than 250 mm in all sections of the streams with trophy-fish regulations in 1974 (Table 10), accounting for more than 6 percent of the catch in those streams (Table 12).

We found that cutthroat trout we captured from the upper tributaries in 1974 averaged longer than trout collected in 1969 by Mauser (1970), 2 years before the trophy-fish regulations went into effect. Fish taken from a section of Gold Creek in 1974 averaged 40 mm longer than those captured in 1969 (Fig. 5). Mauser (1970) captured no fish longer than 250 mm, whereas 7 percent of the cutthroat trout we captured in 1974 exceeded 250 mm in length. The mean length of cutthroat trout caught increased from 133 mm in 1969 (75 fish) to 166 mm in 1974 (36 fish) in Quartz Creek, and from 140 mm in 1969 (86 fish) to 197 mm in 1974 (44 fish) in Bluff Creek.

Table 9. Densities of age I and older cutthroat trout observed in test sections of the study streams and the percentage change from 1973-1975.

Stream	Section	Cutthroat per 100 ft^2				Cutthroat per 100 ft^3			
		1973	1974	1975	% Change	1973	1974	1975	% Change
Closed to fishing									
Reeds Creek	Lower	1.50	2.70	1.75	16.7	1.67	2.46	1.67	0.0
	Upper	2.65	2.93	3.32	25.3	1.89	1.95	2.01	6.3
Bond Creek	Lower	1.02	0.58	0.73	-28.4	0.93	0.45	0.51	-45.2
	Middle	2.17	2.11	1.59	-26.7	1.98	1.40	1.06	-46.5
	Upper	1.20	1.15	1.39	15.8	1.09	1.04	1.32	21.1
Trout Creek	Lower	0.33	0.67	0.28	-15.1	0.27	0.52	0.22	-18.5
	Middle	1.41	1.11	1.73	22.7	0.78	0.66	0.92	17.9
	Upper	4.79	5.44	6.67	39.2	4.35	4.94	6.36	46.2
Mica Creek	Lower	0.25	0.43	0.47	88.0	0.18	0.31	0.33	83.3
	Middle	0.29	0.40	0.96	231.0	0.15	0.20	0.46	206.7
	Upper	0.33	0.58	0.32	-3.0	0.30	0.52	0.29	-3.3
	Upper[a]	1.27	1.61	1.51	18.9	1.15	1.47	1.35	17.4
Open to fishing									
Big Creek	Lower	0.07	0.17	0.11	57.1	0.04	0.09	0.06	50.0
	Middle	0.31	0.63	0.52	67.7	0.15	0.27	0.21	40.0
	Upper	2.03	1.46	1.28	-36.9	1.45	1.04	0.95	-34.5
Marble Creek	Lower	0.04	0.05	0.02	-50.0	0.01	0.02	0.01	-24.2
	Upper	0.36	0.42	0.26	-27.8	0.18	0.18	0.10	-44.4
Trophy-fish regulations									
Quartz Creek	Lower	1.42	1.57	1.18	-16.9	0.95	0.98	0.72	-24.2
	Upper	1.62	1.80	1.58	-2.5	1.01	1.13	1.05	-4.0
Simmons Creek	Lower	0.52	0.69	0.45	-13.5	0.40	0.58	0.31	-22.5
	Upper	1.14	0.77	0.69	-39.5	0.60	0.43	0.34	-43.3

[a] Brook trout densities.

Within the closed streams, we observed more cutthroat trout longer than 250 mm in the inaccessible than in the accessible sections (Table 11). Large cutthroat trout captured by angling also made up a larger proportion of the catch in the inaccessible sections than in the accessible sections (Table 12), 6 percent and 2 percent, respectively, in 1974. Trout longer than 200 mm made up 23 percent and 10 percent, respectively. Inaccessible sections of Bond, Trout, Big, and Marble creeks also had longer fish than accessible sections (Table 10), while in Mica Creek, cutthroat trout captured by angling were significantly longer and four times more numerous in the inaccessible sections (Fig. 6). In streams with trophy-fish regulations since 1971, the mean length of cutthroat trout captured was similar for accessible and inaccessible sections.

Cutthroat Trout Fry

We observed significantly more cutthroat trout fry in the closed streams in 1974 and 1975 than in 1973 (Tables 11 and 13). The increased numbers of fry coincided with increased numbers of large cutthroat longer than 250 mm in these sections. In addition, in sections of the closed streams where we observed more fry in 1974, we also observed more juvenile trout (under 150 mm in length) in 1975. The abundance of cutthroat trout fry did not increase significantly in stream sections where numbers of age I and older trout did not increase significantly. Cutthroat trout fry were usually more abundant in the upper than in the lower stream sections (Table 13).

Cutthroat Trout in Association With Other Salmonids

Although cutthroat trout were the most common species present, wild brook trout and hatchery-reared rainbow trout were present in substantial numbers in certain stream sections (Table 3).

We observed more brook than cutthroat trout in the meadow sections of Mica Creek. After 1 year of closure, the abundance of cutthroat trout increased by 70 percent and that of brook trout by 50 percent (Fig. 7). After 2 years of closure, the abundance of cutthroat trout decreased to the 1973 levels, while brook trout numbers remained similar to the 1974 levels. Mean length of cutthroat trout captured by project personnel increased from 140 mm in 1973 to 166 mm in 1974 (Table 10). The mean lengths

Table 10. The mean total length of cutthroat trout captured by angling from the study streams in 1973 and 1974 and the percentage which exceeded 200 mm and 250 mm total length.

Stream and type of regulation	Stream section	Date sampled	Fish in sample	Mean total length (mm)	Percentage of fish over	
					200 mm	250 mm
Closed to angling						
Reeds Creek	Upper	July 1973	21	167.2	14.3	0
		July 1974	33	170.8	27.3	6.1
Bond Creek	Lower pasture	June 1973	21	134.8	4.8	0
		June 1974	25	173.6	24.0	12.0
	Lower	June 1973	238	129.2	4.6	0
		June 1974	102	130.3	2.9	1.0
	Upper	June 1973	92	147.3	9.8	0
		June 1974	63	155.0	11.1	1.6
Trout Creek	Lower	June 1973	44	168.6	11.4	6.8
		June 1974	48	166.1	20.8	6.3
	Middle	June 1973	21	150.1	4.8	4.8
		June 1974	18	183.2	33.3	5.6
	Upper	June 1973	267	144.4	6.0	0.4
		June 1974	56	151.0	1.8	0
Mica Creek	Lower	July 1973	33	163.6	18.2	3.0
		July 1974	80	161.1	13.8	2.5
	Middle	July 1973	38	192.3	39.5	23.7
		July 1974	69	186.9	29.0	10.1
	Upper	July 1973	51	149.5	13.7	0
		July 1974	124	165.7	18.5	0
	Upper[a]	July 1973	48	163.4	16.7	0
		July 1974	88	159.1	10.2	0
Open to angling						
Big Creek	Upper	Aug. 1973	23	169.7	–	0
		July 1974	84	164.9	14.3	2.4
Marble Creek	Upper	Aug. 1973	53	170.9	–	0
		Aug. 1974	63	168.7	17.5	1.6
Trophy-fish regulations						
Quartz Creek	Lower	July 1973	66	171.2	25.7	3.0
		July 1974	157	170.7	21.7	2.5
	Upper	Aug. 1973	36	166.0	19.4	0
		July 1974	47	176.6	34.0	6.4
Simmons Creek	Lower	July 1973	45	198.3	–	15.6
		Aug. 1974	97	180.6	27.8	8.2
	Upper	Aug. 1973	17	197.7	–	11.8
		Aug. 1974	126	187.0	28.6	8.7

[a] Brook trout.

of captured brook trout were similar in 1973 and 1974. In 1974 and 1975, the combined density of cutthroat and brook trout in the meadow section was large, and was exceeded in only three sections of the other study streams (Table 9).

Rainbow trout virtually disappeared from sections of Big Creek in 1974, when no fish were stocked (Fig. 8). Densities of wild cutthroat trout in these lower sections of Big Creek more than doubled during the same period. In 1975, when the stocking of catchable-sized rainbow trout was resumed in lower Big Creek, densities of cutthroat trout declined. In Marble Creek, catchable-sized rainbow trout were stocked annually, and the density of cutthroat trout remained low (0.05 trout per 100 ft^2) from 1973 to 1975 (Fig. 8).

Table 11. Mean numbers of cutthroat trout (by length groups) counted in snorkeling transects in St. Joe River tributaries closed to fishing, open to fishing, with trophy-fish regulations, and with or without road access, 1973-1975. Calculated *t* values for the change, 1973 to 1974 and 1973 to 1975.

Angling regulation and accessibility	Degrees of freedom	Fry					50-150 mm total length					150-200 mm total length				
		Fish observed			Calculated *t* values d.f. in parentheses		Fish observed			Calculated *t* values for change		Fish observed			Calculated *t* values for change	
		1973	1974	1975	1973-1974	1973-1975	1973	1974	1975	1973-1974	1973-1975	1973	1974	1975	1973-1974	1973-1975
Closed to fishing																
Accessible	26	6.15	20.6	12.40	3.435*(16)	2.107*(26)	5.26	9.41	9.78	3.5483*	2.6927*	3.74	5.15	3.59	2.2185*	.2506
Inaccessible	23	8.71	20.9	12.66	2.886*(19)	1.764*(23)	3.96	4.00	9.37	.0566	4.4943*	5.13	4.54	4.46	1.1272	.9084
Open to fishing																
Accessible	12	2.00	1.13	1.15	1.333(7)	0.755(12)	1.38	2.31	3.00	1.4309	2.2981*	2.46	4.54	2.08	1.8774*	.7889
Inaccessible	9	8.10	–	10.7	–	1.717(9)	7.50	5.20	6.40	1.0854	.5702	6.7	9.10	5.10	2.1287*	1.8091
Trophy-fish regulations																
Accessible	13	10.33	9.67	2.55	0.322(7)	3.715*(7)	6.64	6.57	3.64	.0616	3.6642*	4.64	6.86	4.64	2.2243*	0.0
Inaccessible	4						1.20	2.60	1.60	2.3333*	.3885	5.40	3.40	3.20	1.4510	2.99838*

Angling regulation and accessibility	Degrees of freedom	200-250 mm					>250 mm				
		Fish observed			Calculated *t* values for change		Fish observed			Calculated *t* values for change	
		1973	1974	1975	1973-1974	1973-1975	1973	1974	1975	1973-1974	1973-1975
Closed to fishing											
Accessible	26	0.74	1.41	1.04	3.2249*	1.6880	.19	.37	.52	1.5459	2.2079*
Inaccessible	23	1.79	2.45	1.04	2.3794*	3.4230*	.46	1.00	.87	3.003*	2.1982*
Open to fishing											
Accessible	12	0.77	.54	0.38	.8977	1.2372	0.08	0.0	0.08	1.00	0.0
Inaccessible	9	2.30	2.40	1.40	.2458	2.8620*	0.60	1.00	0.30	1.3093	1.9640*
Trophy-fish regulations											
Accessible	13	3.36	2.86	2.07	1.3915	3.1225*	0.86	1.86	0.79	2.7537*	.2680*
Inaccessible	4	5.00	2.20	3.00	4.2212*	3.1623*	3.20	1.00	1.20	3.7730*	6.3246*

* Denotes significance at 0.05 level.

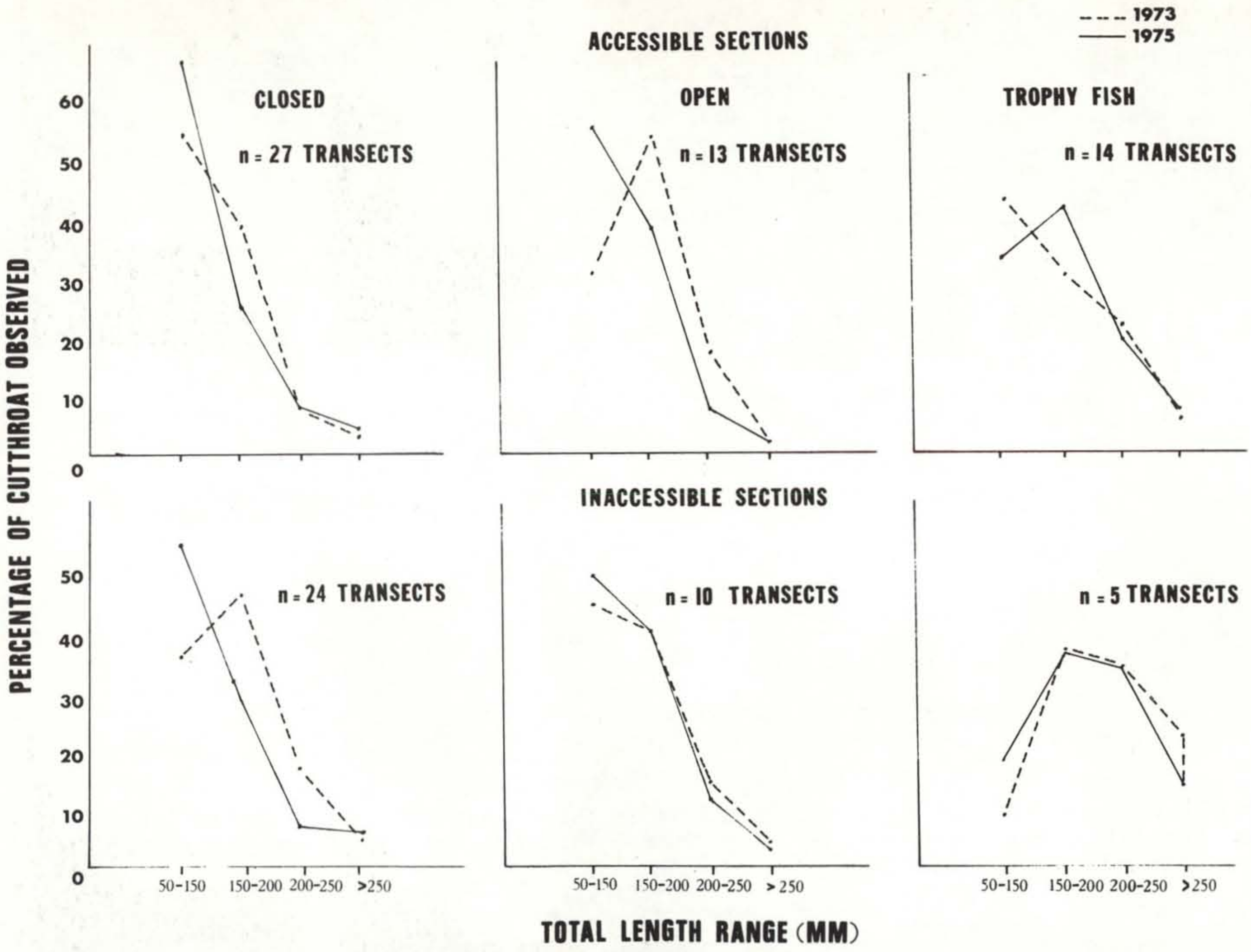


Fig. 4. Length frequency distributions of cutthroat trout counted in snorkeling transects in St. Joe River tributaries closed to fishing, open to fishing, and with trophy-fish regulations, and with or without road access, 1973-1975.

Table 12. Numbers and percentages of cutthroat trout longer than 200 mm and 250 mm captured by angling in the study streams in 1973 and 1974.

Angling regulation and accessibility	Year captured	Sample size	Longer than 200 mm		Longer than 250 mm	
			Number	Percentage	Number	Percentage
Closed Accessible	1973	654	46	7.0	5	0.8
	1974	435	44	10.1	9	2.1
Closed Inaccessible	1973	172	28	16.3	10	5.8
	1974	183	42	22.9	11	6.0
Closed Total	1973	826	74	8.9	15	1.8
	1974	618	86	13.9	20	3.2
Open Inaccessible	1973	76	0	0.0	0	0.0
	1974	147	23	15.6	3	2.0
Trophy Accessible	1973	111	0	0.0	9	8.1
	1974	254	61	24.0	12	4.7
Trophy Inaccessible	1973	53	0	0.0	2	3.8
	1974	173	52	30.1	14	8.1
Trophy Total	1973	164	0	0.0	11	6.7
	1974	427	113	26.5	26	6.1

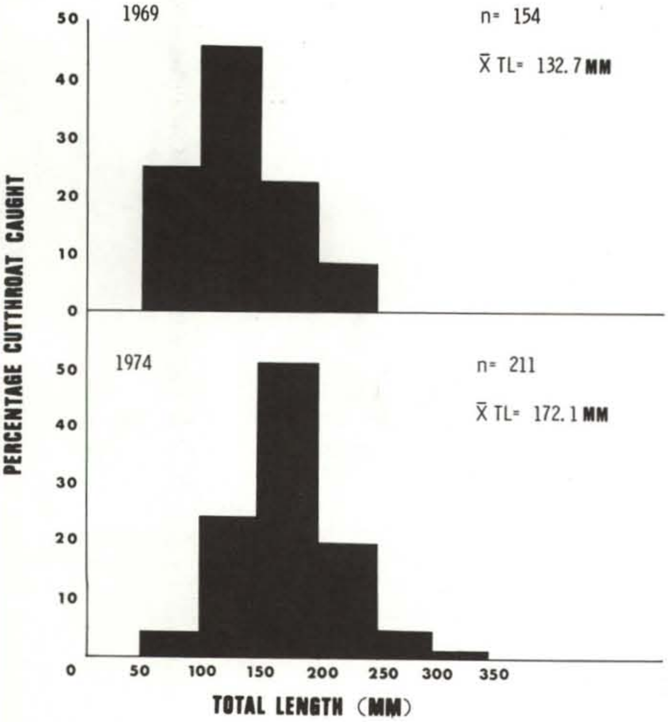


Fig. 5. Length frequencies of cutthroat trout caught in Gold Creek in August 1969 and 1974.

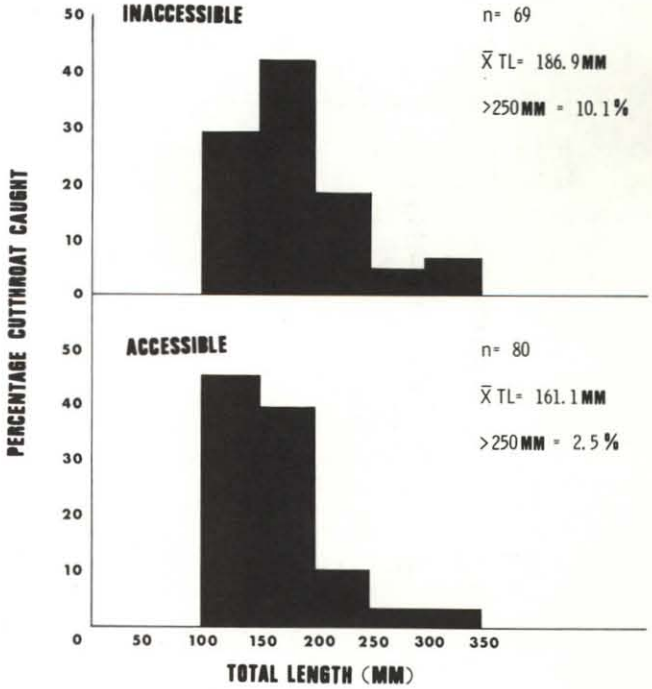


Fig. 6. Length frequencies of cutthroat trout caught in two sections of Mica Creek in July 1974.

Table 13. Mean numbers of cutthroat trout fry counted per transect in each section of the tributaries of the St. Joe River from 1973-1975.

Stream and type of regulation	Section	Fry/transect 1973	1974	1975	Percentage change 1973 to 1975
Closed to fishing					
Reeds Creek	Lower	4.2	0.8[a]	2.8	-33.3
	Upper	6.4	2.0[a]	3.2	-50.0
Bond Creek	Lower	5.0	5.4	4.2	-16.0
	Middle	6.0	6.2	8.2	20.6
	Upper	6.4	10.0	11.6	81.3
Trout Creek	Lower	9.4	21.2	7.0	-25.5
	Middle	8.4	24.6	17.4	107.1
	Upper	11.0	44.6	45.6	314.5
Mica Creek	Lower	3.8	4.0	5.2	36.8
	Middle	15.2	31.8	23.8	56.6
	Upper	0.6	0.4	3.6	500.0
Open to fishing					
Big Creek	Lower	0.2	2.8	1.0	400.0
	Middle	5.6	2.8	3.2	-42.9
	Upper	15.8	14.6	21.4	35.4
Marble Creek	Lower	0.0	0.0	0.0	0.0
	Upper	0.4	0.0	0.0	0.0
Trophy-fish regulations					
Quartz Creek	Lower	9.8	12.0	3.6	-63.3
	Upper	8.8	6.2	1.0	-88.6
Simmons Creek	Lower	n.c.[b]	2.2	2.4	9.1[c]
	Upper	3.4	0.2	1.8	-47.1

[a] Cutthroat trout fry may not have been fully emerged.

[b] n.c. – No fry counts made.

[c] Percentage change 1974-1975.

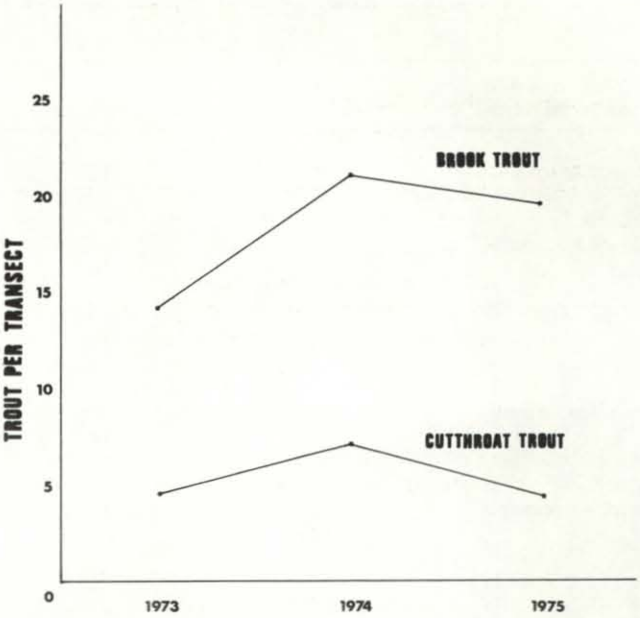


Fig. 7. Change in abundance of cutthroat and brook trout counted in snorkeling transects in the meadow section of Mica Creek, 1973-1975.

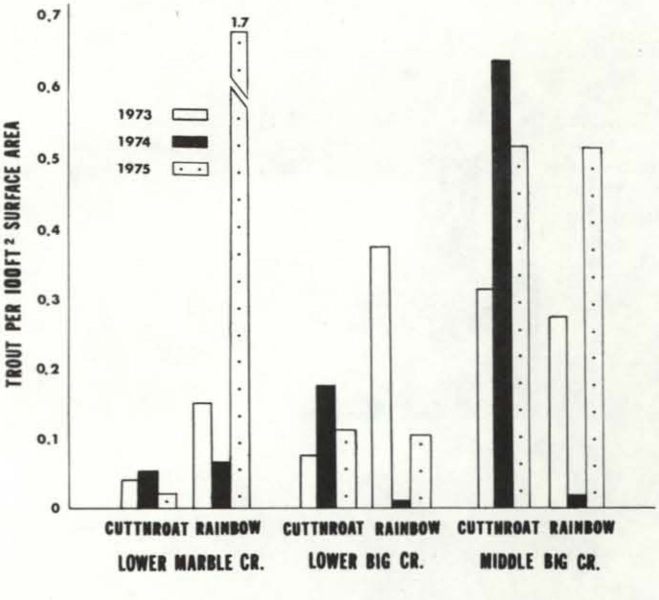


Fig. 8. Mean densities of cutthroat and hatchery rainbow trout observed in stream sections where both species were present, 1973-1975. Rainbow trout catchables were stocked in Marble Creek in 1973, 1974, and 1975 and in Big Creek in 1973 and 1975.

CUTTHROAT TROUT MOVEMENTS

Movements Within Tributaries

Most (89%) of the tagged cutthroat trout recaptured and reported to us were taken in the tributary where they were tagged and released (Table 14); for individual tributaries the percentages ranged from 73 to 100 percent (Table 15). Ninety-seven percent (318 fish) of the cutthroat trout recovered during the year tagged, 90 percent (220 fish) recovered after 1 year, and 84 percent (21 fish) recovered after 2 years were recaptured at the locality of release.

Only 7 percent (39 fish) of the tagged cutthroat trout recovered in tributaries were 0.5 mile or more from the release site. The percentage ranged from 4 to 33 percent for individual tributaries (Table 15). Three percent (11 fish) of the cutthroat trout recovered the year tagged, 10 percent (24 fish) recovered after 1 year, and 16 percent (4 fish) recovered after 2 years were recovered either upstream or downstream more than 0.5 mile from the original release location (Table 15). We recovered cutthroat trout in Trout, Mica, and Quartz creeks both upstream and downstream from the release locations.

We recovered 7 to 35 percent of the fish tagged in each tributary (Table 15). Many factors affected the percentage of tagged fish recovered, but angling effort was most important. From 160 to 1,477 cutthroat trout were tagged in each of the eight study streams (Table 15). In some stream sections low trout densities limited the numbers of fish we tagged.

Movements From Tributaries to the St. Joe River

A relatively small percentage of the cutthroat trout tagged and released in tributaries subsequently moved into the St. Joe River and were recovered there (Table 14). Of 62 tagged cutthroat trout recovered after tagging in upper tributaries of the St. Joe River by project personnel in 1969 and 1970 (Rankel 1971), 18 percent (11 fish) recovered from 1969-1972 were taken in the St. Joe River

Table 14. The number of cutthroat trout tagged in tributary streams and recovered in the St. Joe River or tributaries during 1973-1977. (Multiple recaptures in parentheses.)

Location tagged	Recovered in tributaries						Recovered in St. Joe River						Total recovered	Percentage recovered in river
	1973	1974	1975	1976	1977	Total	1973	1974	1975	1976	1977	Total		
Reeds Creek	10	49(10)	19(1)	–	–	78	–	–	–	–	–	–	78	0.0
Bond Creek	5	44(2)	29(3)	–	–	78	–	1	6	5	2	14	92	15.2
Trout Creek	11	108(2)	73(10)	–	–	192	–	4	9	1	3	17	209	8.1
Mica Creek	9(1)	89(5)	59(3)	–	–	157	1	6	16	4	1	28	185	15.1
Big Creek	–	14	4	1	–	19	–	1	3	–	–	4	23	17.4
Marble Creek	–	9(1)	2	2	–	13	–	–	–	–	–	–	13	0.0
Quartz Creek	3	28(2)	5	–	–	36	1	1	–	–	–	2	38	5.3
Simmons Creek	1	17	10	–	–	28	–	3	2	–	–	5	33	15.2
Slate Creek	–	2	–	1	1	4	–	–	–	–	–	–	4	0.0
Skookum Creek	–	–	1	–	–	1	–	1	2	–	–	3	4	75.0
Bird Creek	–	1	–	–	–	1	–	2	–	–	–	2	3	67.7
Eagle Creek	1	–	–	1	–	2	–	–	–	–	–	–	2	0.0
Bluff Creek	–	2	–	2	–	4	1	–	–	–	–	1	5	20.0
Beaver Creek	3	–	–	–	1	4	–	–	1	–	–	1	5	20.0
Red Ives Creek	–	1	–	–	–	1	–	1	–	–	1	2	3	67.7
Sisters Creek	–	–	1	–	–	1	–	–	–	–	–	–	1	0.0
Total	43	364	203	7	2	619	3	20	39	10	7	79	698	11.3
Percentage	6.9	58.8	32.8	1.1	0.3	100.0	3.8	25.3	49.4	12.7	8.9	100.0		

Table 15. Numbers and percentages of cutthroat trout tagged and recovered within tributaries of the St. Joe River, 1973-1975.

			Number recovered in same location as released								Number recovered>0.5 miles from tag location								Recovered in tributaries	
		Number	Same year		1 yr. later		2 yr. later		Total		Same year		1 yr. later		2 yr. later		Total			
Stream	Section	tagged	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Reeds Creek	Lower	64	7		3		–		10		–		–		–		–		10	16
	Upper	162	21		39		8		68		–		–		–		–		68	42
		226	28	100	42	100	8	100	78	100	–	–	–	–	–	–	–	–	78	35
Bond Creek											–		–		–					
	Lower	399	31		7		1		39		–		–		–				39	10
	Middle	64	–		3		–		3		–		–		–				3	5
	Upper	187	17		15		1		33		–		2		1		3		36	19
		650	48	100	25	93	2	67	75	96	–	–	2	7	1	33	3	4	78	12
Trout Creek	Lower	307	52		14		–		66		3		3		2		8		74	24
	Middle	160	19		9		–		28		1		1		–		2		30	19
	Upper	1,010	29		53		5		87		–		1		–		1		88	9
		1,477	100	96	76	94	5	71	181	94	4	4	5	6	2	29	11	6	192	13
Mica Creek	Lower	361	28		16		3		47		–		3		–		3		50	14
	Middle	303	36		9		–		45		5		2		–		7		52	17
	Upper	284	9		9		–		18		–		2		–		2		20	7
	Meadow	244	15		16		1		32		–		2		1		3		35	14
		1,192	88	95	50	85	4	80	142	90	5	5	9	15	1	20	15	10	157	13
Big Creek	Lower	9	–		–		–		–		–		–		–		–		–	0
	Middle	63	2		1		–		3		–		–		–		–		3	5
	Upper	188	9		6		–		15		–		–		–		–		15	8
		269	11	100	7	100	–	–	18	100	–	–	–	–	–	–	–	–	18	7
Marble Creek	Lower	10	1		1		–		2		–		–		–		–		2	20
	Upper	150	7		–		–		7		–		2		–		2		9	6
		160	8	100	1	33	–	–	9	82	–	–	2	67	–	–	2	18	11	7
Quartz Creek	Lower	226	20		5		–		25		–		5		–		5		30	13
	Upper	100	–		2		1		3		2		1		–		3		6	6
		326	20	91	7	54	1	100	28	77	2	8	6	46	–	–	8	23	36	11
Simmons Creek	Lower	175	6		5		1		12		–		–		–		–		12	7
	Upper	179	9		7		–		16		–		–		–		–		16	9
		354	15	100	12	100	1	100	28	100	–	–	–	–	–	–	–	–	28	8
Grand total		4,654	318	97	220	90	21	84	559	93	11	3	24	10	4	16	39	7	598	13

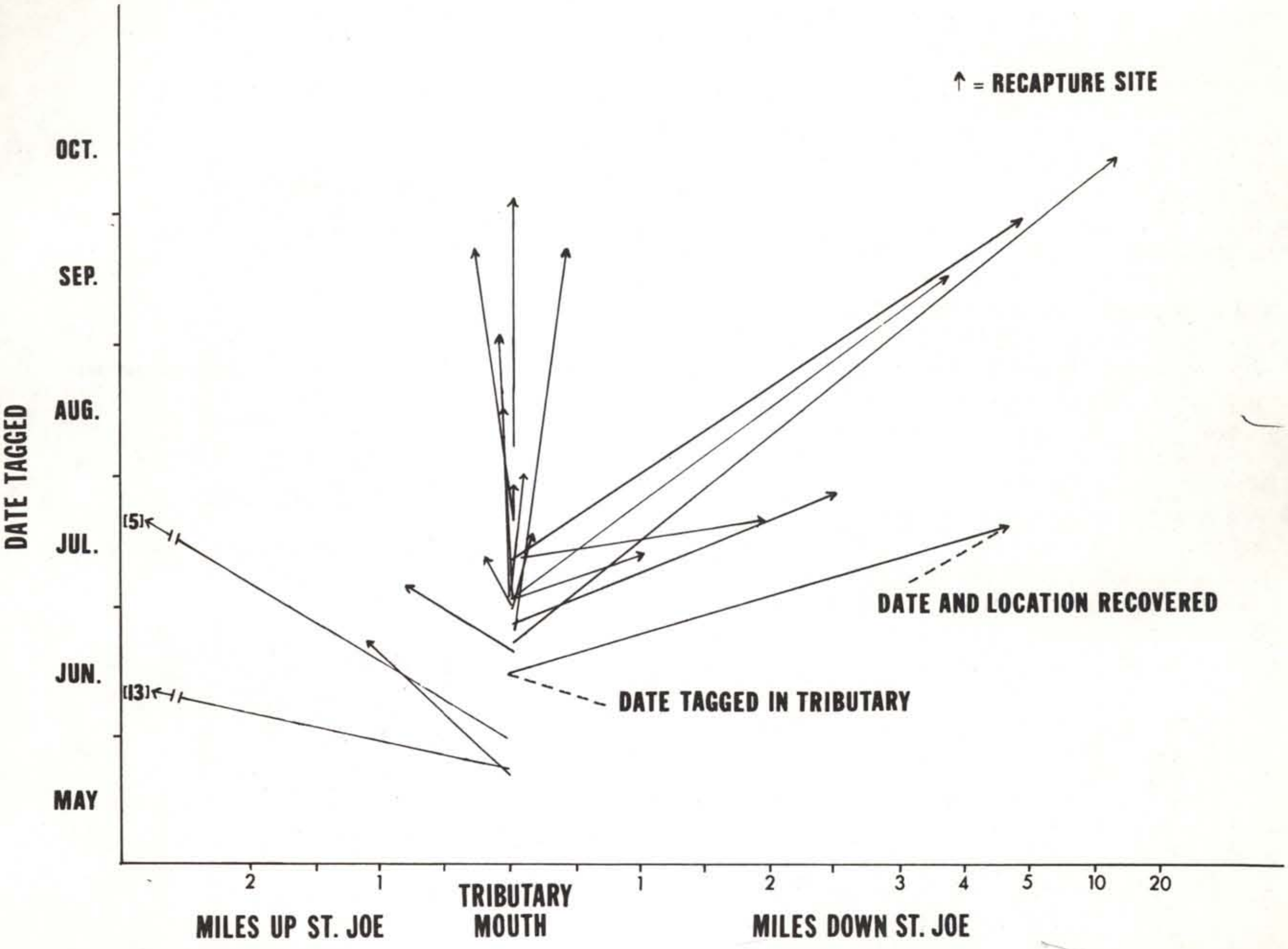


Fig. 9. Movement of cutthroat trout from the mouth of their home tributary upstream or downstream in the St. Joe River. Only fish tagged and recovered within the same year are included.

(Table 16). Eleven percent of the 698 cutthroat trout we recovered from 1973-1977 from 1973-1975 tagging in lower tributaries were recovered in the St. Joe River.

Tagged cutthroat trout recovered in the St. Joe River from 1973-1977 came from 11 different tributaries (Table 17). Most (89%) of the cutthroat trout recovered in the St. Joe River were captured, tagged, and released in the lower 3 miles of the tributaries.

Table 16. Numbers of cutthroat trout recaptured in the St. Joe River through 1977 which had been captured, tagged, and released in its tributaries.

Years of tagging	Tagged cutthroat trout released in tributaries	Tagged trout recovered	Tagged cutthroat trout recovered in the St. Joe River	
			Number	Percentage of those recovered
1969-1970	1,174	62	11	17.7
1973-1975	5,828	698	79	11.3
Totals	7,002	760	90	11.8

Table 17. The location of tributaries in the St. Joe River drainage from which tagged cutthroat trout migrated to the St. Joe River, 1973-1977.

Location of tributaries in the St. Joe drainage	Area description	Number of tributaries from which recovered fish had migrated to the St. Joe River	Number of tributaries in which tagged cutthroat trout were released
Slack water	Falls Creek to Coeur d'Alene Lake	1	2
Lower river	Falls Creek to Marble Creek	3	4
Middle river	Marble Creek to Prospector Creek	2	4
Upper river	Upstream from Prospector Creek	5	7
Total		10	17

Most of the cutthroat trout tagged in tributaries and later recovered in the St. Joe River migrated to the river in spring and early summer (Fig. 9). Of the 21 cutthroat trout recovered in the river the year they were tagged in a tributary, 86 percent had migrated to the river before 10 July. Most were recovered within 1 mile of the mouth of the tributary in which the trout were tagged. Nearly equal numbers of trout were recaptured upstream and downstream from the mouth of their home tributary.

Cutthroat tagged in tributaries and later recovered in the St. Joe River were 100-430 mm long when tagged (Fig. 10); those 100-250 mm long when tagged had probably lived in a tributary one or more summers before entering the river.

Most of the tagged fish recovered in the St. Joe River had been tagged in tributaries during the summer preceding the year of their recapture, and consequently were larger when they entered the river than when tagged. Of 36 trout recaptured in the St. Joe River from 1973 to 1975 which had been tagged in tributaries 1 or 2 years before recovery (Fig. 11), 39 percent (14 fish) were

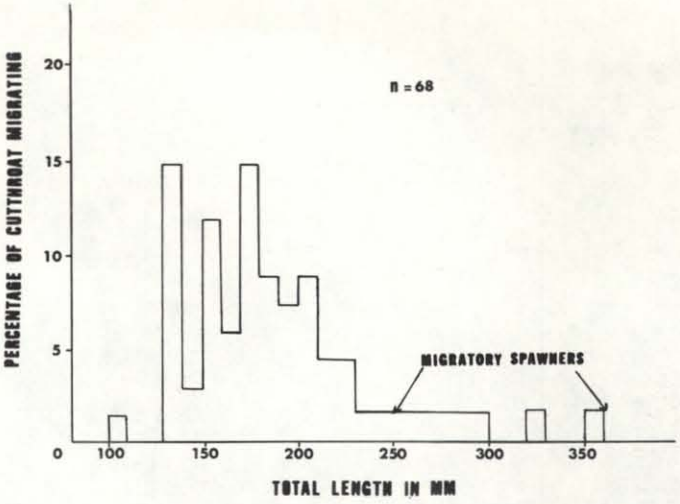


Fig. 10. Length at tagging of recaptured cutthroat trout which migrated from tributaries to the St. Joe River, 1973-1975.

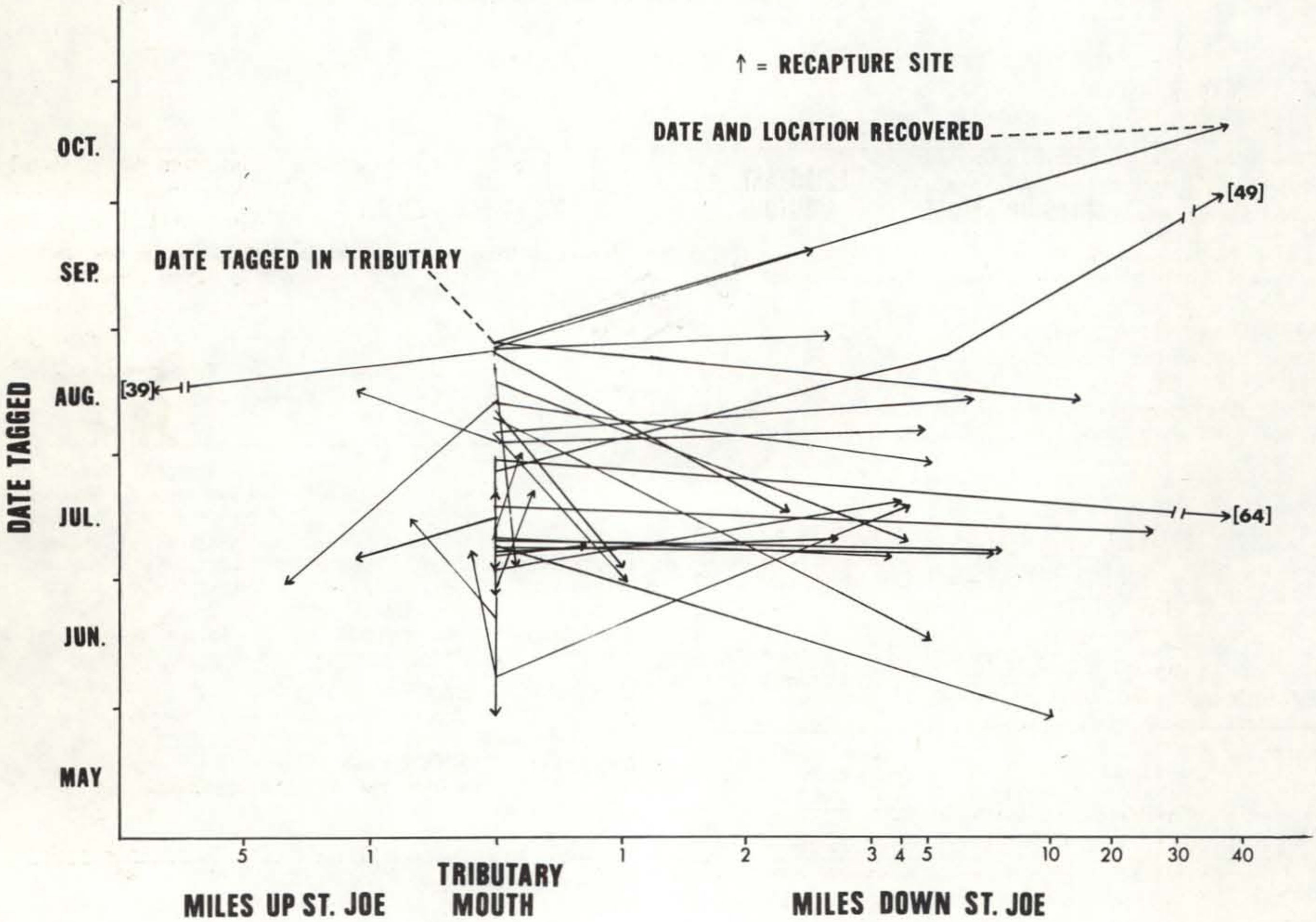


Fig. 11. Movement of cutthroat trout from the mouth of their home tributary upstream or downstream in the St. Joe River. Only fish recovered within 2 years after tagging are included.

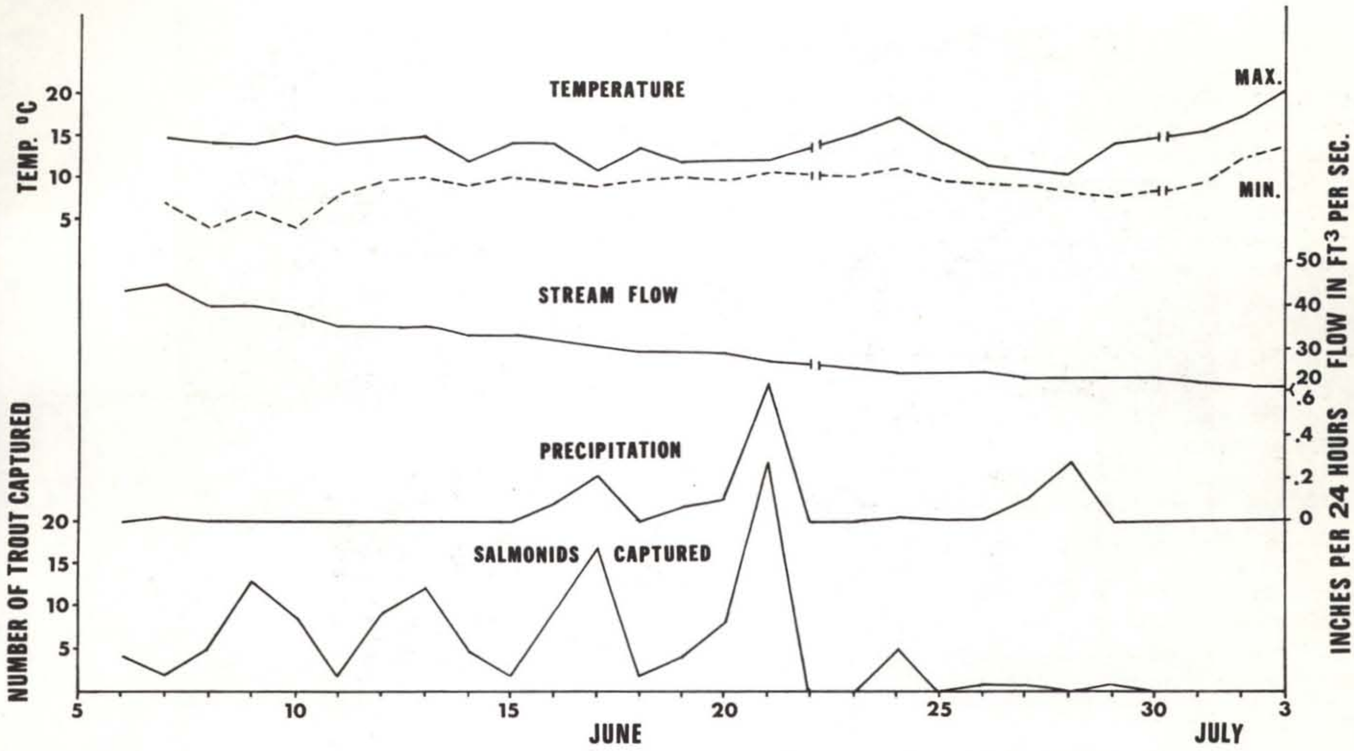


Fig. 12. Stream discharge, water temperature profiles, precipitation, and salmonids captured at Bond Creek weir, June 1975.

recovered within 1 mile of the mouth of their home tributary, 50 percent (18 fish) from 1 to 64 miles downriver, and 11 percent more than 1 mile upriver.

At a weir installed in Trout Creek, 180 m upstream from its confluence with the St. Joe River, in 1974 we captured one spent male cutthroat trout (379 mm long) and 10 juveniles (70-210 mm long) in the downstream trap from 1-30 June. Although we maintained the weir until mid-November, we captured only one cutthroat trout after 30 June. The juveniles were 50 percent age I and 50 percent age II.

At a weir installed in Bond Creek, 550 m from its confluence with the St. Joe River, in 1975, we captured 138 cutthroat trout in the downstream trap from 5 June to 29 June (Fig. 12). Most of the fish (92%) were 100-170 mm long; the mean was 142 mm (Fig. 13). These trout were of ages I and II (using Averett 1963 length-age data) and had lived in Bond Creek for one or two summers before their spring migration to the St. Joe River.

We captured 31 large cutthroat trout spawners in May and June 1975 by angling in the lower section of Bond Creek. The average length of 19 females was 334.6 mm (range 269-420 mm) and that of 12 males was 366.8 mm (range 256-430 mm). The sex ratio was 1.0 male to 1.6 females. On the basis of their condition when captured, we believe that most spawned before 25 May.

Some of the large spawners migrated out of Bond Creek soon after spawning, while streamflows were relatively high, but others remained in the creek through the summer. Three spawners recaptured in the St. Joe River, which we had tagged and released in Bond Creek before completion of the weir on 5 June, had migrated from Bond Creek in late May or early June. We captured eight spawned-out cutthroat (240-400 mm long) in the Bond

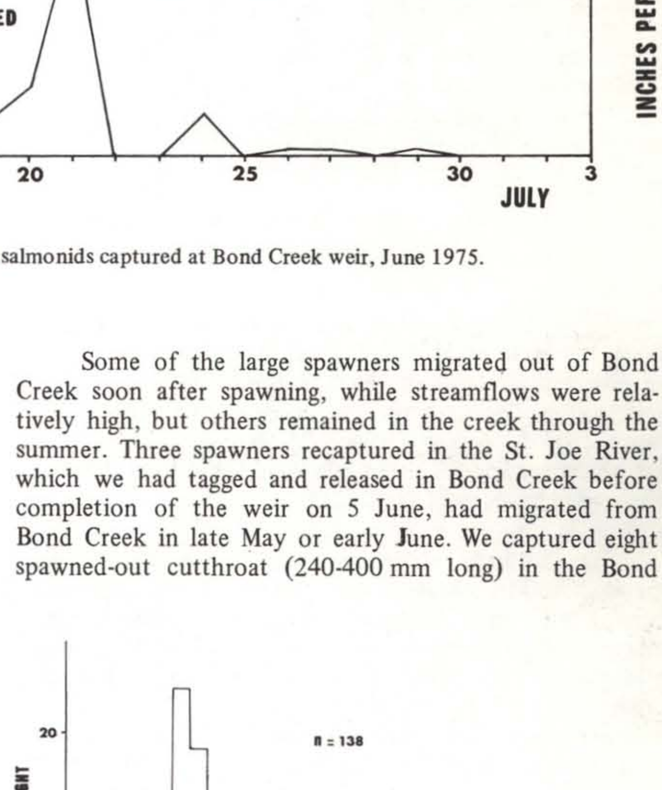


Fig. 13. Length frequencies of cutthroat trout which migrated past the Bond Creek weir, June 1975.

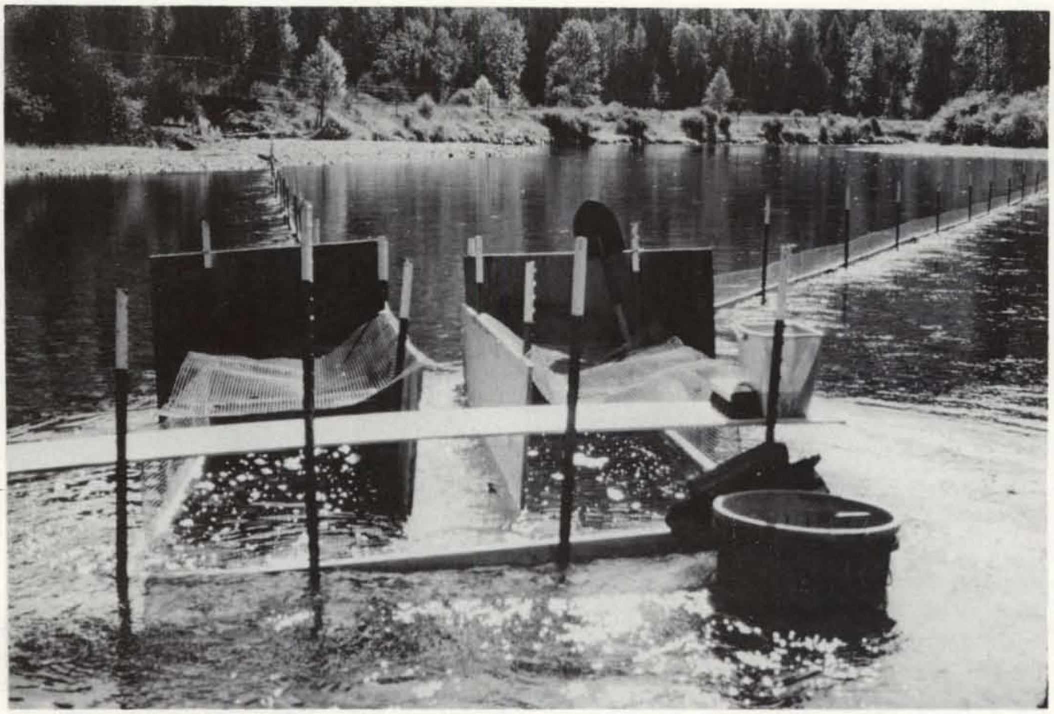


Fig. 14. Upstream view of weir constructed in the St. Joe River. Fish entered the trap at the center of the photograph. Trout Creek joins the river 100 yards upstream at the left bank.

Creek weir during June, of which three had been tagged above the weir in May and June. With snorkeling gear, we observed 23 large spawners in Bond Creek above the weir in July. We captured two more of the spawners in the weir on 23 August (after a 24-hour rainfall), but the rest of the spawners had not left Bond Creek by 9 October when we removed the weir.

We captured 24 cutthroat trout fry in the trap we operated in Fire Creek Draw (tributary to Bond Creek) from 4 July to 5 September 1975. We originally constructed the trap to determine if the fry migrated from the stream into Bond Creek soon after emergence. If large numbers of these fry migrate into Bond Creek, they do so in either late fall or early spring after living in the creek for a summer. We did not observe any age I or older cutthroat in Fire Creek Draw in 1973, 1974, or 1975, although many fry were present each year. The fry may have been the progeny of large fluvial or adfluvial spawners similar to those captured in Bond Creek in 1975.

Movements in the St. Joe River

Returns of cutthroat trout tagged and released in the St. Joe River indicated that the fish moved downstream in fall and upstream in spring and early summer. Little movement occurred during mid-summer. From 1973 to 1976, we recovered 44 cutthroat from the St. Joe River which had been tagged and released there (Table 18); most were recovered in the year they were tagged. All trout tagged and recovered within the same summer (15) had not moved more than 0.5 mile from the release site. Seven of eight fish tagged in the summer and recovered in the fall were caught more than 1 mile downstream.

Fish recovered in the spring more than a year after tagging were recaptured downstream from their summer (June to August) tagging location; when recaptured in summer most were within 1 mile of their tagging site (Table 18).

Table 18. Numbers and (in parentheses) percentages of cutthroat trout tagged in the St. Joe River and recovered at various distances from tagging locations in the same and later years. All fish were tagged in June, July and August of 1973-1975.

	Recovered same year as tagged (23 fish)		Recovered 1 or 2 years after tagging (18 fish)		
Movement in miles, and direction[a]	Same month as tagged	After August	1-2 mos. earlier in summer	Same month as tagged	1-2 mos. later in summer
5+ upstream			1 (11.1)		
1	15 (100)	1 (12.5)	1 (11.1)	3 (60)	3 (75)
1-5 downstream		2 (25.0)	4 (44.4)	1 (20)	
5+ downstream		5 (62.5)	3 (33.3)	1 (20)	1 (25)

[a] No tagged fish were recovered 1-5 miles upstream.

Table 19. Species composition of 237 fish captured during 40 operating days of the Big Eddy weir in the St. Joe River, near Trout Creek, September-October 1973. (See Fig. 1 for locations.)

Species	Period of movement		
	Daylight	Darkness	Totals
Cutthroat trout	6	33	39
Henrys Lake cutthroat[a]	1	9	10
Rainbow trout	6	16	22
Dolly Varden	2	2	4
Brook trout	1	–	1
Mountain whitefish	86	7	93
Longnose sucker	21	34	55
Bullhead	3	10	13

[a] Cutthroat trout from Henrys Lake in southern Idaho were reared in a pond adjacent to Rochat Creek (near Reeds Creek, Fig. 1) and released in the spring of 1973.

The Big Eddy weir was put into operation in the St. Joe River (Fig. 14) on 9 September 1973. We captured 39 cutthroat trout as they migrated downstream, including one fish originally tagged in Mica Creek (Table 19). The capture of fish less than 150 mm long (Fig. 15) indicated that small as well as large cutthroat trout migrated down the St. Joe River in the fall.

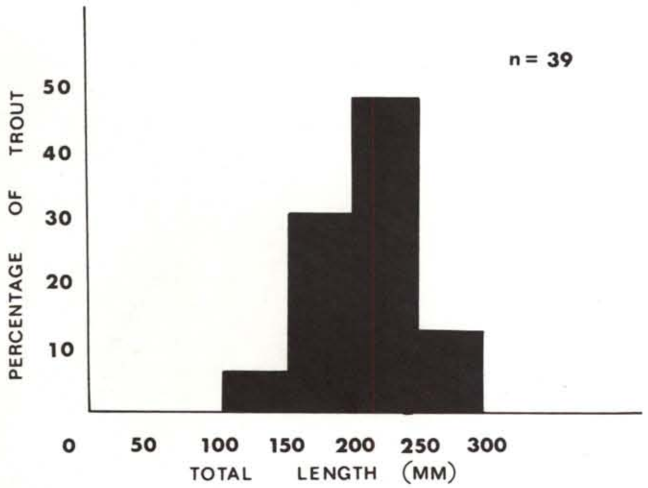


Fig. 15. Length frequencies of cutthroat trout which migrated past the weir in the St. Joe River near Big Eddy (river mile 37.6), September and October 1973.

Most of the trout migrated during darkness and after maximum water temperatures had declined below 60°F (Fig. 16). Chapman and Bjornn (1969) and Bjornn (1971) suggested that declines in water temperature initiate downstream movement of trout in the fall. Although we captured more trout after stream discharge increased abruptly, the flow increase was probably not the primary releasing mechanism. Increased streamflows prevented operation of the weir after early October.

We recaptured five cutthroat trout originally tagged at the Big Eddy weir (Table 20) – four upstream from the weir site in mid-summer, 1974. The recaptured trout had migrated downriver in the fall and upriver in the spring or early summer.

We also captured brook and rainbow trout, Dolly Varden, and mountain whitefish at the Big Eddy weir (Table 19). We captured 76 immature whitefish (average length 120 mm) between 1200 and 1600 hours on 20 October. Pettit and Wallace (1975) reported a similar downriver migration of juvenile whitefish in Kelly Creek, Idaho. We also captured longnose suckers, *Catostomus catostomus*, and sculpins at the weir.

Table 20. Movement of cutthroat trout tagged while migrating downstream past the Big Eddy weir in the St. Joe River, below the mouth of Trout Creek (See Fig. 1 for locations.)

Date of release, and length (mm)	Date and locality of recovery[a]	Movement (miles) and direction[b]
September 14, 1973 262	August 14, 1974 Near Sisters Creek	33.3 U
September 17, 1973 257	July 9, 1974 Below Calder	4.3 U
September 21, 1973 268	September 30, 1973 Below Big Eddy	.2 D
September 21, 1973 273	July 7, 1974 Below Big Creek	9.0 U
September 25, 1973 171	July 5, 1974 Near Tin Can Flat	39.0 U

[a] See Fig. 1 for locations
[b] U = upstream; D = downstream

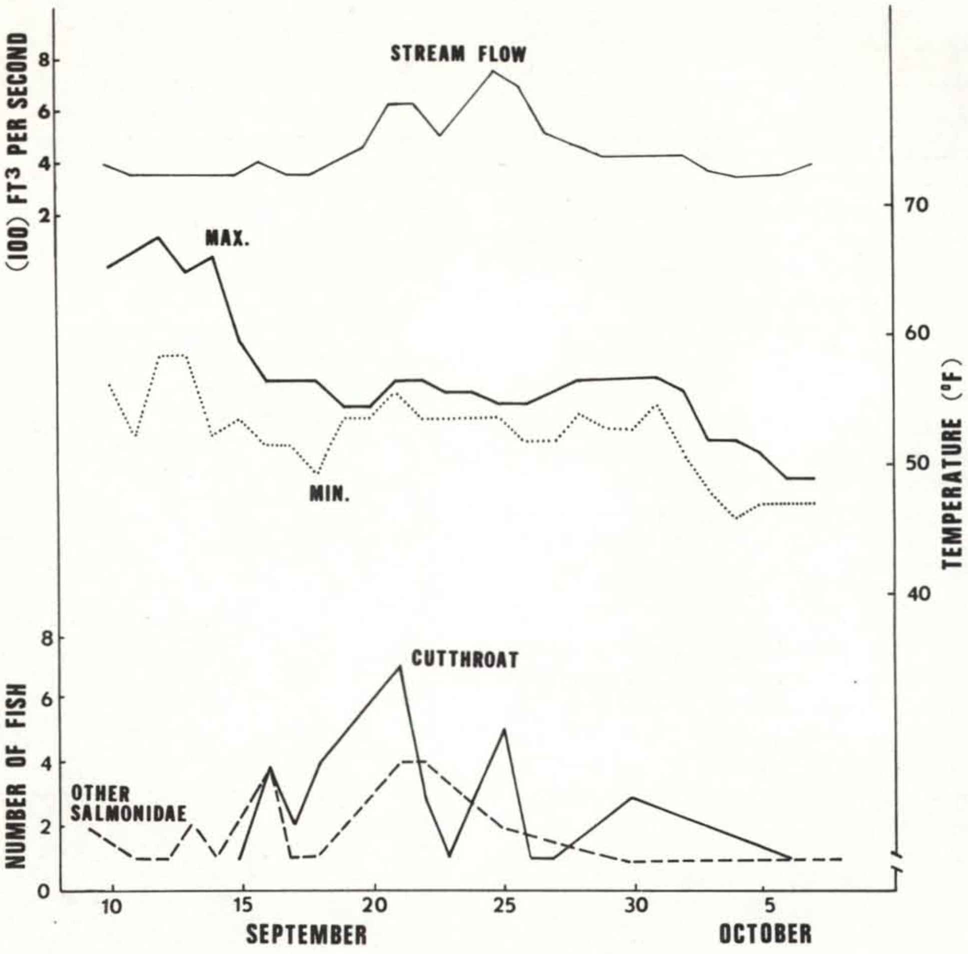


Fig. 16. Stream discharge, water temperature profiles, and number of salmonids captured at Big Eddy weir (river mile 37.6), St. Joe River, Idaho, 1973. Stream flows were recorded at Calder, Idaho, stream gauge (river mile 42.9).

MATURITY OF CUTTHROAT TROUT

Most cutthroat trout longer than 150 mm which we examined from the upper section of Trout Creek were mature – i.e., they had spawned the previous spring or would spawn the following spring (Table 21). Of the fish 100-150 mm long, 25 percent of the females and 33 percent of the males were mature. Males matured at shorter lengths than females, as Mauser (1970) also observed in fish from tributaries of the St. Joe River.

We collected only one mature cutthroat trout (a 189-mm male) from lower Bond Creek (Table 21). The lack of small, mature fish in lower Bond Creek is additional evidence that many of the small trout may be offspring of fluvial or adfluvial spawners and may enter the St. Joe River as juveniles.

Table 21. Percentages of cutthroat trout of different lengths that were mature in collections from the lower section of Bond Creek and the upper section of Trout Creek, September 1975. (Sample size in parentheses.)

Locality and length (mm)	Males	Females
Lower Bond Creek[a]		
100-150	0 (10)	0 (7)
151-200	25 (4)	0 (6)
Upper Trout Creek		
100-150	33 (9)	25 (12)
151-200	100 (13)	85 (13)
>200	100 (4)	100 (3)

[a] No fish taken were longer than 200 mm.

CREEL CENSUS

Anglers fished an estimated 1,016 days in Big Creek from 22 June to 1 September 1974. Angler effort was largest during the period from 13 July to 10 August (Table 22). The largest amount of angler use usually occurs during the first few weeks of the fishing season, but large discharge in Big Creek made angling difficult during this period in 1974. Most (71%) of the anglers fished in the section of Big Creek easily accessible by road (Table 23). Nearly equal numbers of anglers used flies, worms, or combinations of flies and live bait, or lures (Table 23).

Table 22. The estimated numbers and percentages of angler days fished and cutthroat trout caught from Big Creek by anglers in 1974.

Inclusive dates	Angler days		Cutthroat trout caught		Catch per angler day
	Number	Percentage	Number	Percentage	
6/22-7/12	314	30.9	304	22.6	.97
7/13-8/10	405	39.9	566	42.0	1.40
8/11-9/1	297	29.2	476	35.4	1.60
Total	1,016		1,346		1.32

Table 23. The number and residence of anglers censused, the stream sections fished and baits used by anglers during the Big Creek creel census for census intervals I, II, and III, 1974.

Category	Inclusive dates I 6/22-7/12	II 7/13-8/10	III 8/11-9/2	Total and means
Number of fishermen sampled	33	35	30	98
Mean size of party	2.1	3.4	1.8	2.1
Angler residence (%)				
Idaho	74	57	46	60
Washington	16	31	43	29
California	5	9	7	7
Other	5	3	4	4
Stream section fished (%)				
Roaded	63	80	67	71
Above road	24	20	30	24
Both	9	–	3	4
East Fork	4	–	–	1
Bait used (%)				
Fly	46	28	27	34
Worm	27	40	30	33
Multiple	21	23	30	24
Other live	–	3	13	5
Spin lure	6	6	–	4

Table 24. Species composition (%) of 1,567 trout creeled during the Big Creek census, 1974.

Species	22 June-12 July	13 July-10 Aug.	11 Aug.-1 Sept.	Entire season	Number caught
Cutthroat trout	71.3	91.7	90.4	86.0	1,346
Brook trout	14.9	5.7	8.5	9.0	141
Rainbow trout	13.8	2.5	1.1	5.0	80

We estimated that anglers harvested 1,567 trout from Big Creek from 22 June to 1 September 1974 (Table 24), of which 86 percent were cutthroat trout, 9 percent were brook trout, and 5 percent were rainbow trout. During the census period, anglers caught 1,346 cutthroat trout in 1,016 days of fishing for an average catch per angler day of 1.32 (Table 22). Fifty-three percent of the angling trips were successful. Since an average angler day lasted about 4 hours, anglers in Big Creek creeled 0.33 cutthroat trout per hour. The catch per angler day was smallest from 22 June to 12 July – probably because of the relatively large flows in Big Creek at that time.

Projection of the harvest from Big Creek to other tributaries indicates that the combined harvest of cutthroat trout from accessible tributaries probably exceeded that from the St. Joe River. In 1973, when the Idaho Department of Fish and Game conducted a creel census on the lower St. Joe River from Falls Creek to Prospector Creek (Goodnight and Mauser 1974), they estimated that anglers fished 20,949 hours and harvested 12,782 trout, of which 3,904 (30.5%) were wild cutthroat trout or

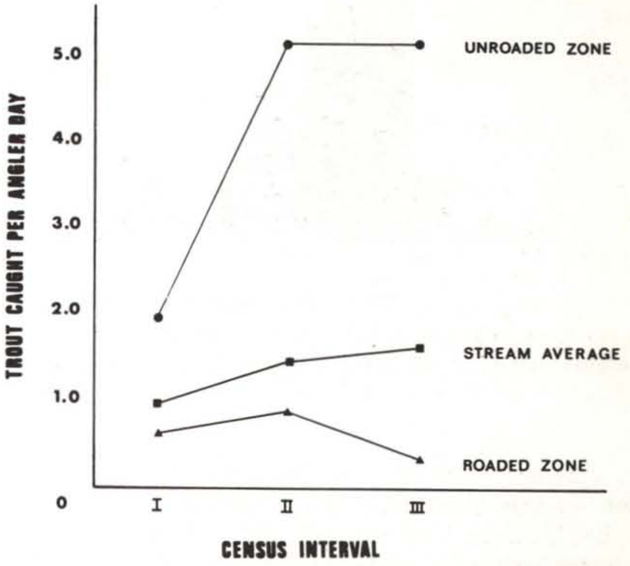


Fig. 17. Catch of cutthroat trout per angler day from Big Creek by season interval and stream zone, 1974.

rainbow-cutthroat hybrids. The catch rate for wild cutthroat trout or hybrids averaged 0.18 fish per hour in the river compared with the 0.33 fish per hour we estimated for Big Creek.

Most of the anglers we interviewed fished the section of Big Creek with road access (Table 22), even though the catch rate was one-sixth that in the section accessible only by trail (Fig. 17). The larger catch rate in the inaccessible stream section reflected the larger number of trout present (Table 4). In the section without road access, the catch-and-keep rate increased from two fish to five fish per angler day as the season progressed and stream flows decreased (Fig. 17). In the section with road access, however, the catch rate declined as the summer progressed.

Cutthroat trout 150-220 mm long (age II and III) made up 68 percent of the harvest of this species from Big Creek (Fig. 18). Only 5 percent of the creeled cutthroat trout were less than 150 mm long. Most of the anglers who kept these small fish stated that the fish had been deeply hooked and would have died if they had been released. Large cutthroat trout (>250 mm) comprised only 6 percent of the observed catch. We did not see any large cutthroat while we were snorkeling transects in the zone of Big Creek accessible by road, and only 6 percent of the cutthroat trout we observed in the inaccessible zone were large (Table 3).

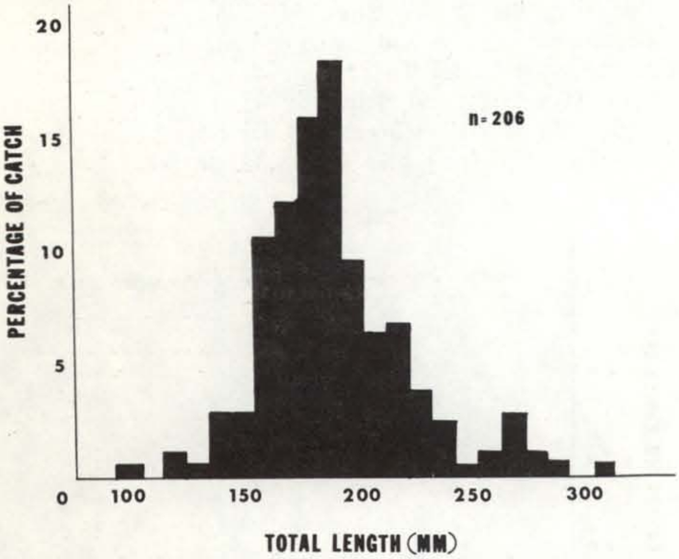


Fig. 18. Length frequencies of a sample of cutthroat trout caught by anglers during the Big Creek creel census, June to September 1974.

Although trout of any size could be kept in Big Creek, 51 percent of the fly fishermen and 41 percent of the bait fishermen released fish. Bait fishermen (using worms) and fly fishermen contributed almost equal percentages of the days fished (33 and 34%), but worm fishermen took 41 percent of the total fish caught, and fly fishermen took only 29 percent. Fishermen who used more than one type of bait took 16 percent of the harvest while fishing 25 percent of the days.

Relatively few anglers of exceptional skill take a disproportionately large share of the catch (Hunt, Brynildson and McFadden 1962). Of the 207 anglers registered, 14 percent creeled 5 or more fish and accounted for 72 percent of the total observed catch of cutthroat trout from Big Creek. Only 2 percent creeled a legal limit of 10 fish.

ANGLER OPINION SURVEY

Most anglers who fished Big Creek preferred to catch cutthroat trout or had no species preference, believed the quality of fishing had declined in recent years, and would accept some type of restrictive regulation or supplemental stocking to improve the quality of angling. The specific questions posed to anglers and their responses (as percentages of people in sample) follow:

1. *Question:* How would you rate the fishing in Big Creek?

Anglers Interviewed	Response (%) Poor	Fair	Good
85	48	27	25

2. *Question:* Are there any species which you prefer to catch while fishing in Big Creek?

Anglers Interviewed	98
	Percent
Cutthroat trout	38
No preference	37
Brook trout	8
Rainbow trout	7
Cutthroat and rainbow	6
Cutthroat and brook	2
Other	2

3. *Question:* How does fishing in Big Creek in 1974 compare with that in other years?

Anglers Interviewed	Response (%) Declining	No change	Improving
53	74	24	2

4. *Question:* Does fishing in Big Creek need improvement?

Anglers Interviewed	Response (%) Yes	No
83	80	20

If yes, how could we improve fishing?

Anglers Interviewed	Response (%) Restrictive regulations	Stocking	Closure	Closure & stocking	Other
45	38	38	11	9	4

5. *Question:* Do you prefer fishing tributary streams to fishing the main St. Joe River?

Anglers Interviewed	Response (%) Yes	No
94	93	7

If yes, why?

Anglers Interviewed	86
	Response (%)
Easy access	27
Better fishing	20
Esthetics	14
Fewer fishermen	13
Access & fishing	2
Camping	1
Other	23

6. *Question:* If restrictive regulations on tributary streams benefited the cutthroat fishery in the main river would you favor these regulations?

Anglers Interviewed	Response (%) Yes	No
93	61	39

7. *Question:* If the closure of tributary streams to angling benefited the cutthroat fishery in the main river would you support the closures?

Anglers Interviewed	Response (%) Yes	No
91	35	65

Although a large percentage of the anglers preferred fishing tributary streams, many favored restrictive regulations on tributary streams if the regulations benefited the cutthroat fishery in the main St. Joe River. Respondents may have assumed that restrictive regulations would benefit the cutthroat fishery in the tributaries. However, as Rankel (1971) noted, most of the anglers he interviewed wanted to preserve the cutthroat trout population in the St. Joe River; responses to question 6 may reflect this sentiment. Many of the tributary anglers, however, did not favor closure of the tributary streams as a means of improving the cutthroat fishery in the St. Joe River.

DISCUSSION

Response of Cutthroat Trout to Protective Angling Regulations

The closure of tributaries to angling increased the abundance of cutthroat trout longer than 200 mm, especially in the accessible sections of the streams. After a 3-year closure, the abundance of large trout increased as a result of the reduced angling mortality rate. Alexander (1971) reported a similar response in a brook trout population when angling ceased.

Initially we assumed that the cutthroat trout populations present in the closed streams during the first year of closure (1973) were representative of exploited populations. We now believe this assumption was false. We observed fewer cutthroat trout in the lower sections of the control streams open to angling than we did in the closed streams in 1973. Since we completed our first abundance estimates in August, the trout population in the closed streams had been protected from anglers for 2 months before our counts. Additional cutthroat trout were present in August 1973 which would have been removed if angling had been permitted in June and July. Although we do not know, we can estimate the proportion of the population that would have been removed by assuming that the tagged trout we observed in the transects when snorkeling could have been removed by anglers rather than tagged and released (Table 25). Twenty percent of the trout observed

Table 25. Numbers of tagged and untagged cutthroat trout (>100 mm) observed in the snorkeling transects in 1974 and 1975.

		1974			1975		
Stream	Section	Total trout observed	Tagged trout observed	Percentage tagged	Total trout observed	Tagged trout observed	Percentage tagged
Reeds Creek	Lower	34	4	11.8	21	6	28.6
	Upper	60	23	38.3	65	26	40.0
Bond Creek	Lower	38	10	26.3	43	7	16.3
	Middle	58	6	10.3	50	1	2.0
	Upper	49	8	16.3	33	6	18.2
Trout Creek	Lower	61	4	6.6	26	3	11.5
	Middle	66	23	34.8	69	12	17.4
	Upper	176	24	13.6	168	30	17.9
Mica Creek	Lower	38	17	44.7	39	6	15.4
	Middle	50	13	26.0	114	14	12.3
	Upper	30	8	26.7	17	9	52.9
Totals		660	140	21.2	645	120	18.6

during snorkeling had been tagged earlier in the summer. Theoretically, anglers could have harvested 20 percent or more of the fish in accessible sections of the streams.

Within accessible stream sections, angler harvest limited the density of cutthroat trout. Radford (1975b) believed 70-76 percent of the cutthroat trout longer than 150 mm were harvested by anglers in the Oldman River, Canada. In Red Ives Creek (tributary to the St. Joe River), Rankel (1971) noted that trout abundance dropped 59 percent and cutthroat trout longer than 200 mm virtually disappeared after the stream was reopened to angling.

Other biologists have observed the rapid response which cutthroat trout exhibit when restrictive angling regulations limit harvest. In Kelly Creek, Idaho, Chapman, Pettit and Ball (1973) observed a threefold to sixfold increase in cutthroat trout abundance after 2 years under a catch-and-release regulation. Johnson and Bjornn (1975) observed three to five times more cutthroat trout in the upper St. Joe River after 4 years of trophy-fish regulations. Radford (1975a and 1975b) noted that cutthroat trout in Dutch Creek and the Oldman River, Alberta, grew to a more desirable size when fishing was permitted only in alternate seasons. In Silver King Creek, California, biologists noted a 10-fold increase in numbers and pounds of Piute cutthroat trout per acre after an 8-year period of closure to angling (E.C. Fullerton, personal communication). Lowry (1966) also observed an increase in abundance of coastal cutthroat trout in tributaries closed to angling.

Alexander (1971), Chrystie (1965), Gowing (1975), and Gard and Seegrist (1972) found that trout over 170 mm long responded fastest to protective angling regulations. In tributaries of the St. Joe River, we believe that the abundance of large cutthroat trout increased as a result of the closure to angling, and that the abundance of juveniles increased in 1975 as a result of the larger numbers of spawners in 1974 and 1975.

The smaller numbers of cutthroat trout we observed and the smaller mean length of trout captured in the lower, accessible portions of each stream may have been due to current or previous angler harvest. However, a combination of factors, including unsuitable water temperatures and inadequate spawning recruitment, may have contributed to the smaller numbers of fish. Mauser (1970) also encountered fewer cutthroat trout in lower than in upper sections of tributaries of the St. Joe River.

The statistically significant increases in trout abundance in the accessible sections of the closed streams in 1974 reflected a recovery of the cutthroat population after angler harvest was eliminated. In 1975, after nearly three summers of closure, trout densities in accessible and inaccessible sections of the closed streams were similar. In the streams open to angling, we observed larger numbers of cutthroat trout in the inaccessible sections throughout the study period. In streams under trophy-fish regulations since 1971, densities in accessible and inaccessible sections were similar. Paetz (1957) observed that angler harvest in readily accessible streams in South Saskatchewan was sufficient to remove most mature fish, and that larger numbers of mature fish were present after a 1-year closure.

The abundance of large trout in tributary streams which have been under trophy-fish regulations since 1971 provides an index to the population structure which cutthroat trout reach after extended periods of protection from angling. After a sufficient number of years of no angling, the effects of angling on the size distribution of cutthroat trout in streams is presumably eliminated. Although large fish (>250 mm but <330 mm long) are relatively abundant in tributaries of the St. Joe River closed to angling, trophy-sized (>330 mm) fish will not be abundant even after an extended period of closure because of the slow growth rates in the tributaries (Averett and MacPhee 1971).

We observed significantly more cutthroat trout fry in sections of the closed streams where significantly more large fish were present. Benson (1960) in Arnica Creek, Wyoming, and Drummond and McKinney (1965) in tributaries of Trappers Lake, Colorado, found, however, that the number of spawners was not consistently related to the production of immature cutthroat trout. Bulkley and Benson (1962), Drummond (1966), and Latta (1965) observed a direct correlation between water flows and year class strength. Although other authors have found that the abundance of cutthroat trout fry may be due to environmental conditions which affect their survival, rather than to increased numbers of mature trout, we believe additional mature cutthroat trout can increase the abundance of cutthroat trout fry when the population has been severely overfished. The increased abundance of spawning-sized fish in 1974 and 1975 could have been directly responsible for the increase in juvenile trout in 1974 and 1975. We observed increased numbers of cutthroat trout fry and juveniles only in stream sections where larger numbers of large trout were present in 1974 and 1975 than in 1973. The increase in fry in 1974 was followed by an increase in yearlings in 1975 in the same sections.

The large number of brook trout and relatively small number of cutthroat trout in the meadow section of Mica Creek suggest a differential effect of angling on the two species. MacPhee (1966) observed that cutthroat trout were nearly twice as vulnerable to angling as brook trout. Although the density of cutthroat trout may have been reduced by previous angler harvest, the meadow section cessation of angling did not change the relative abundance of brook trout and cutthroat trout (Table 3).

Brook trout made up over 70 percent of the trout we observed in Mica Creek, even after 2 years of closure.

Griffith (1974) suggested that brook trout do not effectively displace cutthroat trout. As Dettman (1974) observed while studying rainbow trout-squawfish (*Ptychocheilus* sp.) interaction, a high percentage of one species versus another does not necessarily indicate that either is dominating the system in a competitive sense. The physical environment in the meadow (low facing velocities and undercut bank cover) may provide more suitable habitat for brook than for cutthroat trout. Nilsson (1963) discussed a type of interactive segregation in which one species is more efficient in a habitat than another species; such segregation may have occurred in Mica Creek meadow. As Griffith (1974) observed, sympatrically induced adaptations which segregate these two species may result in more efficient use of a stream. In Mica Creek, the total yield from a sympatric population of cutthroat and brook trout may exceed the yield from a population of either species alone.

The Role of Tributaries in the Production of Cutthroat Trout

Tributaries of the St. Joe River support stocks of resident or non-migratory cutthroat trout, as well as migratory (fluvial or adfluvial) stocks. Most of the fish in tributaries, particularly in upper stream sections, were resident fish which remained in tributaries for their entire life cycle; few attained lengths over 300 mm. Many resident trout retained home ranges no larger than a single pool-riffle complex, as Miller (1957) also observed in Gorge Creek, Alberta.

The differences in size at maturity of cutthroat trout between lower and upper stream sections may further substantiate the existence of two stocks of cutthroat trout in tributaries. Resident fish in upper sections of tributaries matured at a relatively small size, whereas fish shorter than 200 mm in the lower sections of tributaries were mostly immature and may have been predominantly progeny of migratory parents that matured in the lake or river.

A relatively small percentage of the cutthroat trout in tributaries from 1973 to 1977 migrated into the St. Joe River. Only 79 of 698 recoveries from 5,828 cutthroat tagged and released in tributaries were later recovered in the river (Table 14). The number of fish tagged and released in tributaries and later recovered in the St. Joe River versus the tributaries was dependent on: 1) the number of trout which migrated from tributaries into the St. Joe River, and 2) the recovery efforts expended in tributaries or the river. The percentage of tributary fish recovered in the river probably does not represent the actual proportion of fish which entered the river because we expended more effort angling in the tributaries than in the St. Joe River. We also did not tag fish shorter than 130 mm, which might have entered the river. Averett (1963) reported that cutthroat which migrated to the river as age I fish (< 130 mm long) made up 28 percent of the adult adfluvial trout he examined. Twenty-five percent of the juvenile cutthroat trout we caught at weirs in Trout and Bond creeks and 37 percent of those Huston (1973) captured as they moved downstream in Hungry Horse Creek in 1972 were 1-year-old fish less than 130 mm long (Table 26).

Table 26. Age and length distribution of cutthroat trout captured while migrating from tributaries (percentage in parentheses).

Location captured	Sample size	Age distribution I	II	III
Tributaries of St. Joe River, 1974-75	141	35(25)	135(74)	1(1)
Total length (mm) at each annulus		71	135	226
Hungry Horse Creek, Montana (Huston 1973)	563	236(37)	205(53)	32(10)
Total length (mm) at each annulus		71	117	155

Averett and MacPhee (1971) and Rankel (1971) reported that migratory cutthroat trout in the St. Joe River typically lived in streams for two or three summers before migrating to the river in spring. Bjornn (1961) and Johnson (1963) reported that most cutthroat trout in Priest Lake, Idaho, and the Flathead River, Montana, respectively, stayed in tributaries for 2 or 3 years. Evidence we collected from trout tagged in lower river tributaries and fish captured in the two weirs indicated that most migratory cutthroat trout enter the river from lower river tributaries after one or two summers. Johnson (1977) found that most cutthroat trout in the upper St. Joe River had spent 2-3 years in tributaries before entering the river.

We believe most cutthroat trout that migrated from tributaries into the St. Joe River were not displaced resident trout. Stream sections with the largest fish densities contributed few trout to the St. Joe River. Although we tagged over 1,441 cutthroat trout in the upper sections of Trout, Mica, and Bond creeks, only 3 of these fish were recaptured in the St. Joe River.

The movement of migratory cutthroat trout from tributaries to the St. Joe River was not density dependent. In tributaries of the St. Joe River, density-regulated movements would probably occur in either late summer or during fall and early winter. As Chapman (1966) observed, "the number of fish carried over the summer in a given stream is positively related to summer streamflow." As streamflow decreases, living space decreases, causing increased interactions of fish. Reduced streamflow in summer did not increase migrations of trout to the St. Joe River at the trout densities we observed in tributaries. In the fall, fish behavior changes and the need for winter cover may also cause increased migrations of trout from tributaries (Bjornn 1971). Few trout moved downstream in fall past weirs we operated on two tributaries. As Mauser (1970) concluded after trapping fish in another tributary of the St. Joe River, trout in excess of winter carrying capacity probably do not provide many recruits to the St. Joe River. We believe fish densities in the study streams did not exceed the summer or winter carrying capacity.

Trout that migrated from tributaries were probably the progeny of migratory fluvial or adfluvial trout which spawned in the lower portions of the tributaries, and their migrations to the river were probably regulated by an innate (genetic) mechanism. Photoperiod may be the primary releaser for innate migratory behavior (Bjornn 1971), but the role of photoperiod as a releaser mechanism for cutthroat trout movements has not been well defined.

Management Implications for Cutthroat Trout in Tributaries

Three conclusions may be drawn from the results of this research which may be applied to cutthroat trout management in the lower river tributaries. First, two stocks of cutthroat trout (resident and migratory) are present in the tributaries of the St. Joe River we studied. These stocks are partially segregated; resident trout are present throughout the streams and migratory stocks are primarily in the lower 3 miles of the streams.

Second, the closure of tributaries to angling increased the abundance and density of cutthroat trout in accessible sections by changing the survival rate of the trout present, and not by immigration of trout from other stream sections. Angler harvest was a critical factor limiting the density of cutthroat trout in accessible stream sections.

Third, we could not determine directly whether the closure of tributaries to angling resulted in an increased number of trout entering the St. Joe River from tributaries, but presumed it would because migratory cutthroat trout live in the lower sections of the tributaries where the number of fish increased after the closure. The abundance of cutthroat trout increased in upper (inaccessible) sections of the closed streams but few migrated to the St. Joe River from these sections.

The conclusions listed above plus the survey of angler attitudes may be used to formulate a management plan for cutthroat trout in the St. Joe River and tributaries. Although we interviewed anglers only on Big Creek, the responses were probably typical of all tributary anglers, since these anglers also fished other tributaries in the St. Joe River drainage. A majority favored restrictive regulations on tributary streams if these regulations would benefit the fishery in the main St. Joe River.

The type of restrictive regulations used would depend on the objectives of the management program, which in tributaries of the St. Joe River might include: 1) increasing the stock of migratory cutthroat trout, or 2) creating an optimal fishery for resident cutthroat trout in tributaries while protecting the migratory stocks of fish.

In the lower portions of tributaries, anglers currently harvest juvenile migratory cutthroat trout before they enter the St. Joe River. Reduction of this harvest would provide additional fish for the St. Joe River fishery.

A reduced creel limit would not effectively reduce the harvest of pre-migratory cutthroat trout. Results of the Big Creek creel census suggest that an average tributary angler creels fewer than five fish; of 207 anglers interviewed, only 11 percent creeled more than five (Table 27). A creel limit of three or fewer fish would be required to reduce the cutthroat harvest in Big Creek. Although the anglers who caught more than three fish creeled 46 percent of the harvest, a three-fish limit may not save all of these trout. A small creel limit may only redistribute the catch to other anglers or cause the fish to be harvested at other times (Radford 1975b).

Table 27. Percentage of anglers in Big Creek who exceeded specified creel limits, and the percentage of the harvest which would theoretically be protected by each creel limit.

Creel limit	Percentage of anglers exceeding the creel limit in 1974	Percentage of trout protected
10 fish	2.0	0.0
5 fish	11.1	24.3
4 fish	15.0	34.4
3 fish	18.4	46.2

A size limit may be an effective means of reducing the harvest of juvenile migratory cutthroat trout. As Hunt (1970) observed, a size limit applies to every trout caught. Although juvenile migratory cutthroat trout may attain lengths of 200-250 mm (8-10 inches) in tributaries, most of them migrate from tributaries at lengths of 120 to 220 mm. An 8-inch size limit would effectively reduce the harvest, since 74 percent of the harvest in Big Creek consisted of cutthroat trout less than 8 inches long (Fig. 19).

Tributaries play an important role in the production of cutthroat trout for the fisheries in the St. Joe River and its tributaries. The angling regulations in 1976 (10 fish bag limit, no size restrictions) allowed anglers to harvest migratory trout which would migrate from the tributaries into the river. Regulations to protect the migratory fish but allow some harvest of resident trout would involve size limits, closed seasons, or stream section closures.

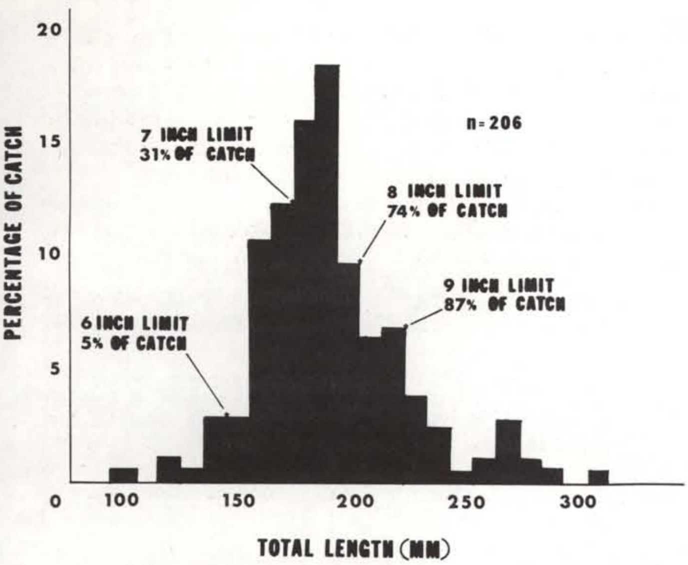


Fig. 19. Length frequencies of cutthroat trout caught by anglers during the Big Creek creel census, June to September 1974, and the percentage of the catch within specified length limits.

With a minimum length limit, many of the trout caught by anglers in lower sections of tributaries would be released. Regulations which attempt to limit the mortality of sub-legal trout usually include an angling method restriction in combination with a size limit. Of the anglers interviewed after fishing Big Creek, 62 percent used bait alone, or in combination with lures. A "flies and lures only" restriction may be unpopular and therefore unenforceable on tributary streams.

A shorter angling season would not effectively limit the harvest of juvenile migratory cutthroat trout in tributaries unless it was very short. Most of the migratory trout destined to leave tributaries any given year leave before 1 July. A later season opening would reduce the harvest of these fish as well as late spawning adfluvial adults. However, a large number of trout which would migrate the following spring could be harvested by anglers fishing tributaries after 1 July. A later season opening (after 15 June) would insure that most of the migratory cutthroat trout spawned before being harvested. With the current May opening, some late spawners may be harvested prior to spawning.

Closing a tributary to angling would protect juvenile and spawning migratory cutthroat trout from anglers; however, the harvest of resident cutthroat trout would be foregone. Alternate year stream closures would protect age I and older fish during the year of closure (Radford 1977) but they might be harvested the next year if they did not migrate to the river in the spring.

Optimum management of cutthroat trout in tributaries of the St. Joe River may necessitate separate angling regulations on lower sections for migratory stocks and upper sections for resident stocks. In upper, inaccessible sections of tributaries where resident cutthroat trout were present, spawning recruitment appeared adequate to support the present fishing intensity and bag limits (10-fish creel limit, no size limit). However, in lower, accessible sections of tributaries, restrictive regulations may be necessary to increase the stock of migratory cutthroat trout. Different regulations on separate areas of a single stream will cause some enforcement problems. However, we believe that with public participation in the selection of management alternatives and adequate posting of information on the streams, two sets of regulations on a single tributary will succeed if the angling public wants to increase migratory cutthroat trout abundance.

Additional restrictive regulations may be needed to improve the river fishery. In the lower St. Joe River, anglers currently harvest juvenile migratory cutthroat trout soon after they enter the river. In 1972 and 1973, 22 percent and 13 percent of the respective harvests of wild cutthroat trout consisted of trout 200 mm long or less (Goodnight and Mauser 1974). An 8-inch (200 mm) length limit on the lower river would eliminate the harvest of small trout.

We suspect that resident trout have expanded their range because: 1) resident trout seem to occupy larger portions of the St. Joe tributaries than of streams with relatively large migratory populations (such as Wolf Lodge Creek, unpublished data, Idaho Cooperative Fishery Research Unit); 2) most if not all tributaries contribute some cutthroat trout to the river and lake, but the numbers seem small based on tagging and limited trapping data; and 3) in recent years, the fishery most likely affected the migratory stocks of fish more than the resident or introduced brook trout stocks.

If our conclusions about separate migratory and non-migratory stocks, and resident cutthroat and brook trout now occupying sections of tributaries formerly used by migratory trout are correct, then action must be taken to expand the distribution of migratory trout into their former range if maximization of migratory trout abundance is the management goal. Regulations which protect migratory fish will eventually allow the population shift to occur, but a more direct approach involving removal of all trout from a tributary and restocking with migratory cutthroat trout fry would probably speed the establishment of migratory trout. This approach cannot be used widely until substantial numbers of fry from migratory cutthroat trout stocks are available.

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