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RIVER AND STREAM INVESTIGATIONS

Subproject II, Study IV
Wild Trout Investigations:
South Fork Payette River Studies

by

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JOB PERFORMANCE REPORT

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ABSTRACT

Idaho Department of Fish and Game (IDFG) placed an 80 km segment of the South Fork Payette River under special regulations beginning in 1992. The study area, from Deadwood River to Grandjean Campground, included a hatchery trout zone and two segments under the new wild trout regulation with different levels of access. This study evaluated the fish populations and sport fishery generated during the first year of the regulations.

During 1992, we estimated wild rainbow trout Oncorhynchus mykiss densities ranging from 1.33-3.79 fish/100 m^2 in the study area via snorkeling. Densities were greater in the wild trout zone (two fish bag) than in the general regulation zone. Mountain whitefish Prosopium williamsoni densities ranged from 0.76-1.15 fish/100 m^2. We observed low numbers of bull trout Salvelinus malma and cutthroat trout O. clarki. Brook trout S. fontinalis only existed in the uppermost section of the river we censused.

We estimated anglers fished 16,010 h and harvested 3845 wild and 4934 hatchery rainbow trout in the study area from May 23 through September 11, 1992. Effort equalled 147 and 135 h/hectare/year in the wild trout zone and general regulation zone, respectively. Return-to-creel of hatchery rainbow trout equalled 55%, well above IDFG plan goals of 40%. Anglers caught few bull, cutthroat or brook trout.

Catch rates averaged 1.85 fish/h (range 1.62-2.21) in the study area. Anglers released 76% of all fish caught. Harvest rates equalled 0.80 fish/h in the hatchery trout zone and 0.25-0.29 fish/h in two portions of the wild trout zone.

Mean size of creeled wild trout equalled 206 mm; none were larger than 300 mm. Yield of wild rainbow trout from angler harvest ranged from 2.5-3.6 kg/hectare/year in the study area.

Fifty-three percent of anglers interviewed were not aware of the new regulation but most (71-83%) indicated they would not change the areas they fished as a result of regulation changes.

Exploitation rates for wild rainbow trout were approximately 20% for 150 to 250 mm fish in the study area. In the hatchery zone, exploitation was estimated at 44% for fish >250 mm. Exploitation was 5% or less for fish >250 mm in the wild trout zone.

Biomass estimates for the South Fork Payette River equalled 7.2 kg/hectare. This **value** is in the lower range for other Idaho streams examined and similar to north Idaho cutthroat trout waters without special regulations.

Compared to other Idaho streams, growth rates were low in the South Fork Payette River based on scale analysis. Wild rainbow trout grew to average lengths of 98, 150, 189 and 233 mm long at ages 1 through 4, respectively, in section 1 and 2. In section 3 length-at-age was slightly lower. Growth estimates are questionable because of small sample sizes for age 4 fish and the possibility of some fish not laying down a first annulus.

We compared scale and otolith age determinations for 18 rainbow trout. We observed 61% agreement between the structures. Estimated scale ages were one year lower than for otoliths in 33% of the samples.

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INTRODUCTION

The South Fork Payette River has sustained a popular fishery for many years. Boise residents have direct access to the fishery via State Highway 21. IDFG has supplemented natural populations in the South Fork Payette River with hatchery rainbow trout releases since the 1950s.

Reid and Anderson (1981) conducted a creel census from Garden Valley upstream to Grandjean and estimated wild rainbow trout supported over 50% of the total trout harvest in 1980. There were few wild fish harvested over 300 mm. Snorkel surveys from 1986 through 1990 (Mabbot and Holubetz 1989 and 1990) indicated high densities of wild trout present in the South Fork Payette River compared to other streams in central Idaho (Rohrer 1989; Rohrer 1990; Thurow 1990).

The 1991-95 Idaho Fisheries Management Plan (IDFG 1991) directed a greater emphasis on wild trout management in rivers and streams. The IDFG plan calls for managing streams for wild trout alone whenever there is potential to provide an acceptable fishery. The IDFG plan calls for elimination or reduction of hatchery stocking in waters capable of supporting satisfactory fisheries with wild trout. Wild trout management may require more restrictive bag and size limits to maintain self sustaining wild trout populations.

During 1991, IDFG proposed regulations for the South Fork Payette River that would divide the river into wild and hatchery trout management zones. River segments from the Deadwood River to Eightmile Creek and from Eightmile Creek to the headwaters were proposed for hatchery trout (six fish bag) and wild trout (two fish bag) management, respectively. Input at public meetings supported restricting harvest on cutthroat and bull trout, but the public had mixed opinions about reducing hatchery releases and restricting harvest of rainbow trout (Terry Holubetz, IDFG, personal communication). Several local property owners upstream from Lowman questioned the capability of the South Fork Payette River to sustain a wild trout fishery.

This study was initiated to increase our knowledge of the fish populations, assess the sport fishery and assess the degree of angler displacement during the first year of the regulation.

OBJECTIVES

1. To estimate densities and size of game fish species in South Fork Payette River upstream of Kirkham Hot Springs.

2. To estimate exploitation rates for wild and hatchery rainbow trout.

3. To conduct a stratified creel census to assess angler use and distribution in the sport fishery upstream of Deadwood River.

4. To assess both angler awareness of the new wild trout regulation and possible displacement of anglers from the wild trout management zone.

5. To assess wild rainbow trout growth and evaluate the potential for growth of larger fish.

6. To assess biomass for wild rainbow trout and compare the value to other Idaho streams.

STUDY AREA

The South Fork Payette River is a tributary to the Payette River located approximately 60 km north of Boise, Idaho (Figure 1). The 52 km study area includes the South Fork Payette River from the confluence with the Deadwood River upstream to the Grandjean Campground and drains 120,500 hectares. The drainage lies in the Idaho batholith and is characterized by highly erosive soils. The river is parallelled by State Highway 21 from Lowman upstream to Grandjean Junction. Highway 21 is a major travel route from Boise to Stanley Basin and is heavily used during summer and fall periods.

Historically, the Payette River Drainage supported anadromous salmonids including chinook salmon O. tshawytscha, sockeye salmon O. nerka, and steelhead trout O. mykiss. Construction of Black Canyon Dam on the mainstem Payette River blocked those migratory stocks beginning in 1926. Resident fish populations also existed in the basin including bull trout, residualized steelhead trout and mountain *whitefish*. Brook trout and cutthroat trout have been introduced into the drainage.

The study area was broken into three sections based on regulations and access (Figure 2). Section 1, from Deadwood River upstream to Eightmile Creek, is managed with hatchery rainbow trout releases and a six fish bag limit. Section 2, (Eightmile Creek to Grandjean Junction) is managed under a wild trout, two fish bag limit with no hatchery release. These sections have excellent paved access along Highway 21 with frequent vehicle turnouts. Section 3 extends from Grandjean Junction upstream to Grandjean Campground, is managed for wild trout (two fish bag limit), and has limited gravel road access.

METHODS

Population Sampling

We selected 15 snorkel stations, 5 per river section, to estimate game fish size and population densities in the South Fork Payette River (Figure 2). We completed snorkel surveys in 14 stations from August 4-11. Station 14 was snorkeled September 10. Approximate site selection within study sections was determined by spacing stations equidistant on U.S. Geological Surveyors topographical maps. We approached the map locations from the nearest access area

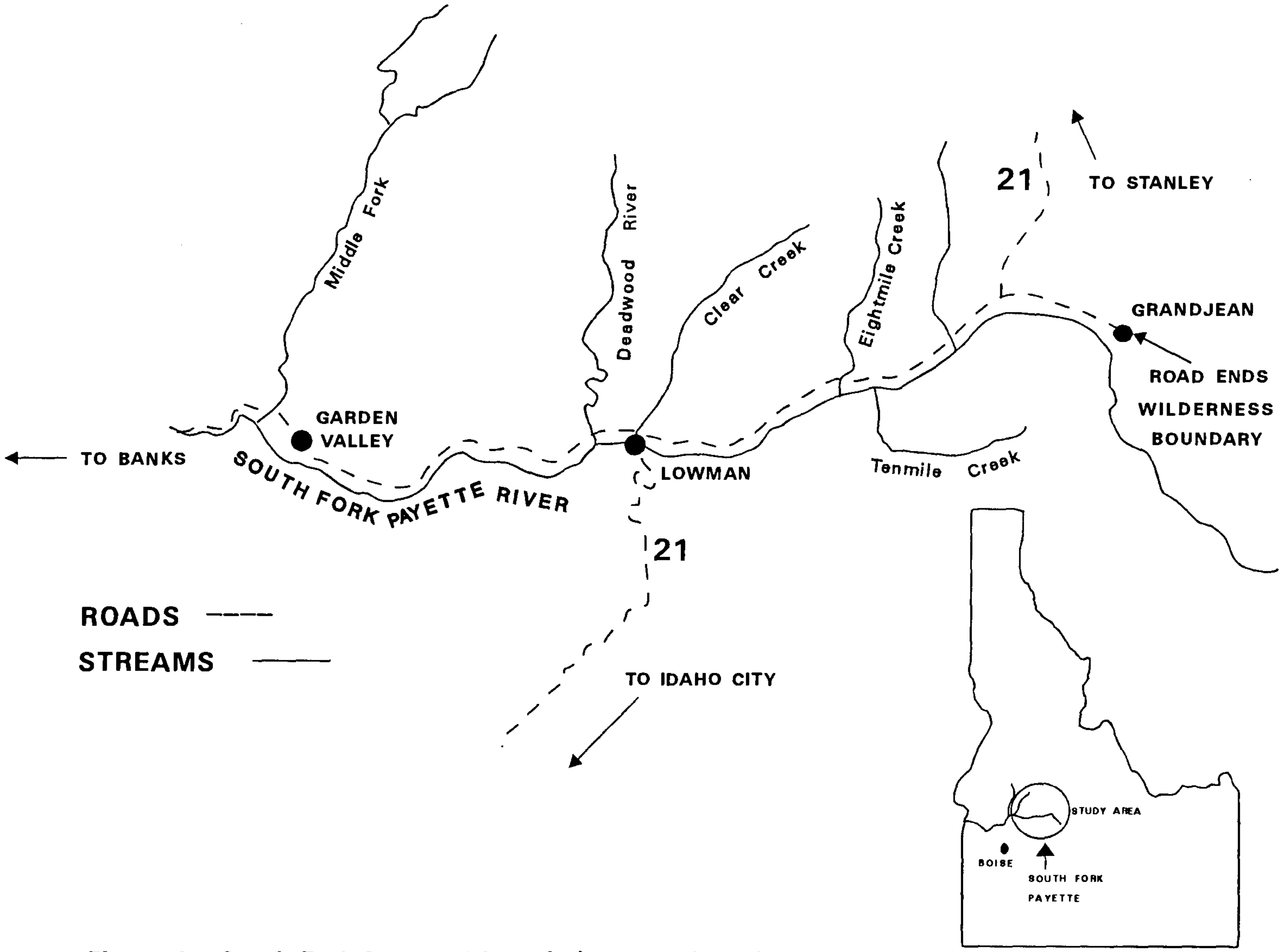

Figure 1. South Fork Payette River drainage and study area map.

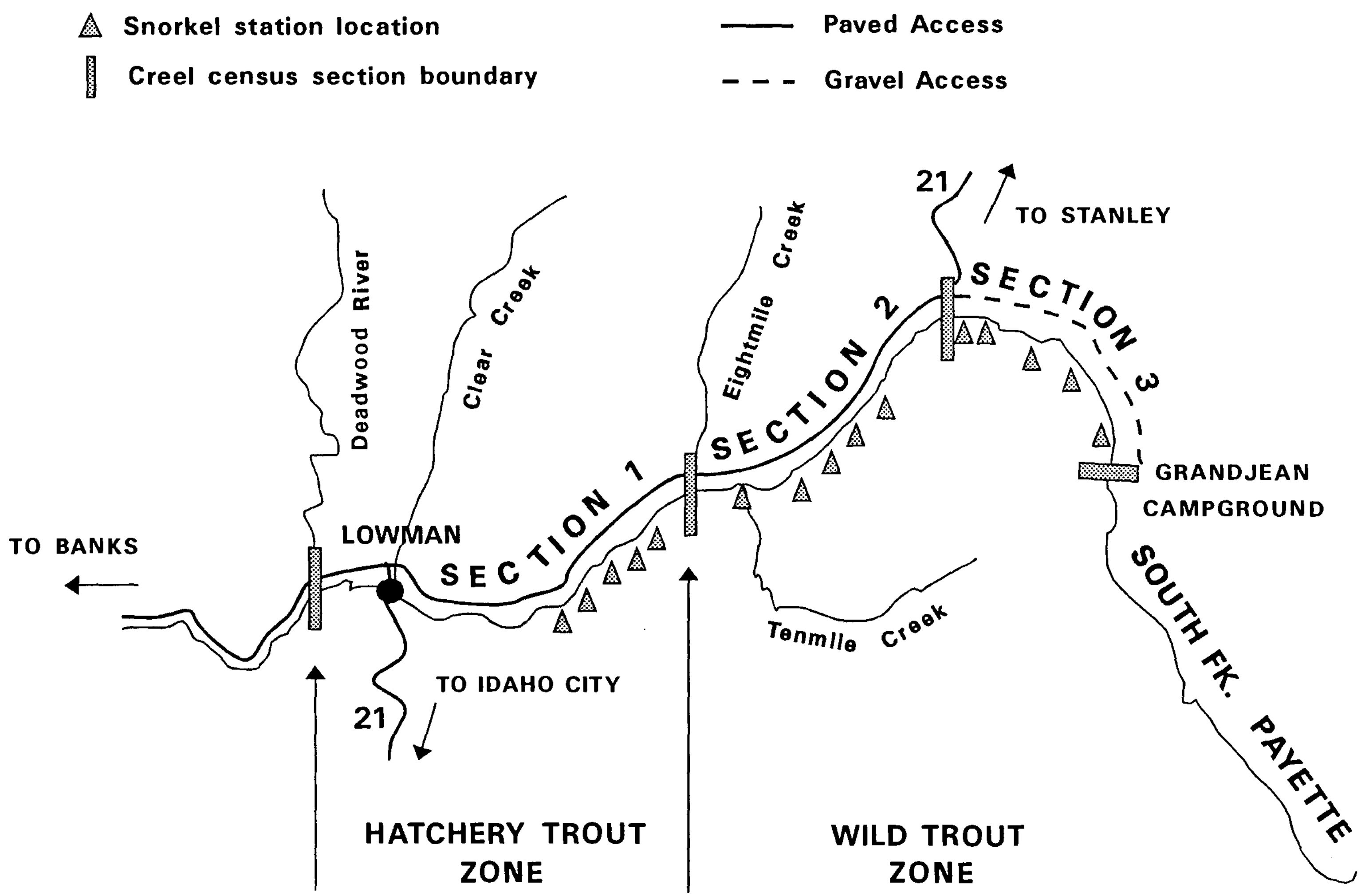

Figure 2. Location of snorkel stations and creel census sections South Fork Payette River, 1992.

and established stations in the first habitat unit upstream from the access. Snorkel stations 1 to 5 were located in the upper one half of Section 1 due to increasing depths in the lower reaches of the section that prevented use of selected snorkel methods.

We classified habitat in each station as in Overton (1992). The potential habitat units were pools, runs, high gradient riffles (HGR), low gradient riffles (LGR) and glides. We sought to include a minimum of three habitat units per snorkeling station. We recorded a written description of all transect sites including reference to landmarks (Appendix A). Sketches with photographs of station boundaries and other prominent instream features are available in IDFG Region 3 files for future location of the stations.

Snorkeling estimates were completed by two to four divers counting from the bottom of each station and moving upstream using available substrate for handholds. Each diver counted only to his left or right to avoid duplication of counts of fish between divers (Schill and Griffith 1984). At times cover, depths, or hydraulics required that divers count fish between each other. In these cases divers actively communicated to avoid duplication.

The snorkel team identified and counted all game fish within station habitat units. Rainbow trout were split between wild and hatchery origin based on fin erosion present on hatchery fish. We further split wild rainbow into length groups of less than 150 mm, 150-250 mm, 250-300 mm, and greater than 300 mm.

Game fish densities were estimated for each habitat unit and for all combined units within a station. We calculated surface areas for each habitat unit by multiplying the unit length by a mean width. Width measurements were taken with a range finder at the bottom, middle, and top of each habitat unit. We calculated densities using the measured surface areas and fish counts in each habitat unit and within each station (combination of units).

For comparison, we estimated total population numbers within the three study sections in two ways. The first method represented the traditional approach used by IDFG, where all fish counted in a station were used as a single count without regard to habitat type. We calculated a mean density and standard deviation for the five stations within a section and extrapolated to obtain a total population estimate per section.

In the second method, we calculated population estimates for each habitat type within a study section and summed them for a total estimate. We multiplied average game fish densities observed in the five habitat types by the estimated total surface area for each habitat type within each of the three study sections. We then added population estimates by habitat type to estimate total populations. Boise National Forest personnel provided us with estimates of the total area and number of units of each habitat type in each section. These data were collected by OEA Consultants under contract during July-August, 1991 using the method of Hankin and Reeves (1988). Visual estimates of station widths, depths, and lengths were made for all habitat units in the study area. At every 10th unit, actual measurements were taken. Visual estimates were calibrated to actual measurements.

We calculated variances and 95% confidence limits for both population estimate methods using the following equations:

Estimated variance of mean =

$$\hat{V}(\overline{x}) = \frac{s^2}{n}(N-n/N) \tag{1}$$

$$s^2 = \frac{\sum x^2 - (\sum x)^2/n}{n-1} \tag{2}$$

where:

n = number of habitat units within a stratification
x = the observed number of fish by species for a given habitat stratification
s^2= variance of sample mean of fish counts
s = standard deviation of the sample counts

Confidence limit = (3)

$$CL = tSE(\overline{x}) = t\sqrt{\hat{V}(\overline{x})}$$

where:

SE = standard error
t = table t-value
V = variance of the population (estimated by s^2)

$$s^2_{x+y+z} = s^2_x + s^2_y + s^2_z \tag{4}$$

Confidence limits are calculated as above (Cochran 1977).

Creel Census

We used a stratified random creel survey to estimate angler effort and harvest in the three study sections from May 13 to September 11, 1992. We divided the census period into four 28-day intervals (Table 1). Intervals were stratified by weekday and weekend day types and morning (0600 to 1400) and

Table 1. Creel census intervals for South Fork Payette River, 1992.

Interval	Dates	Day per interval		Mean daylight (hours)
		Weekend[1]	Weekday	
I	May 23 to June 19	9	19	15.32
II	June 20 to July 17	9	19	15.57
III	July 18 to August 14	8	20	14.56
IV	August 15 to September 11	9	19	13.22

[1] Includes weekend days and holiday.

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afternoon (1400 to 2200) periods. We randomly selected starting times for morning and afternoon counts. We randomly selected 1 weekday and 1 weekend day for angler counts during each week of the census. We also made angler counts on Memorial Day and Fourth of July holidays and combined them with weekend count data for appropriate intervals.

Creel technicians made angler counts by driving adjacent to the South Fork and counting anglers visible from the road. When vehicles but no anglers were observed, we counted vehicles and later adjusted angler counts based on the number of anglers per vehicle determined from interviews. We adjusted vehicle counts by subtracting those vehicles associated with recreation activities other than fishing.

We conducted interviews to sample angler catch and assess information on residence and gear type used. We recorded hours fished and species composition of creeled fish. Anglers were also asked how many fish they had caught and released. We did not ask them to identify the species of fish released. We calculated catch rates for fish harvested, fish released and a combined total.

We recorded lengths (nearest millimeter) and weights (nearest 10 g) for a subsample of creeled fish observed. We calculated condition factors (K = weight/length^3) for each study section (Schreck and Moyle 1990). We calculated yield using the length-weight relationship and the mean length of fish in the harvest.

We used the Creel Census System program developed by McArthur (1992) to input, store, and analyze all census data. The program estimates angler effort and harvest for each study section and computes 95% confidence limits for these estimates.

Regulation Awareness and Displacement

During angler interviews we asked two questions in regard to the new wild trout regulation.

1. Are you aware of the two fish bag limit from Eightmile Creek upstream?

2. Considering the two fish limit, are you more or less likely to fish in the wild trout regulated waters? (This question provided for the response of "no change".) Prior to asking this question we informed anglers about the presence of both the hatchery and wild trout zones on the South Fork Payette River.

Exploitation

We estimated exploitation for wild rainbow trout in each of the three river sections. Based on creel data, wild rainbow trout begin recruiting to the sport fishery at approximately 150 mm. We estimated exploitation for 150 to 250 mm and

>250 mm size classes of wild rainbow trout. We estimated the wild rainbow trout population at the beginning of the 1993 fishing season by adding the estimated harvest from May 23 through August 14 (interval 3) to the estimated populations (using stratification by habitat units) during August snorkeling. Exploitation was calculated by dividing the population estimate at the beginning of the season by the total harvest for the entire season.

Biomass

We calculated a biomass estimate for wild rainbow trout >150 mm in the entire study **area**. We calculated one length-weight relationship ($W = aL^n$) for the study **area** from angler creels (Schreck and Moyle 1990). We utilized the length-weight relationship and the average length of fish from snorkel estimates to estimate an average weight per fish. We calculated standing stock (grams/100^2) from fish density and weight and converted it to kilogram/hectare. To provide perspective we developed biomass estimates for other Idaho streams using data from prior studies. Most studies provided densities and mean lengths without mean weight data. Where data were not available we used length-weight relationships from the literature. For westslope cutthroat trout O. clarki lewisi, we used the values given by Rieman and Apperson (1989). We used the relationship given in Moore (1980) for yellowstone cutthroat trout O. clarki bouvieri populations in southeast Idaho. Moore et al. (1979) provided a length-weight relationship for the South Fork Boise River which we applied to other Boise River studies. Relationships for rainbow and brook trout from the Big Wood River (Thurow 1987 and 1990) were applied to Big Lost and Portnuef river populations. Biomass estimates are for age 1 and older fish.

Age-Growth Analysis

We collected scale samples from wild rainbow trout harvested by anglers. Project personnel collected scales from smaller fish using hook-and-line sampling, primarily is section 3. Scales were pressed on acetate slides and read via a microfiche projector. We assigned annuli based on the end of compressed winter growth and the presence of a complete, unbroken circuli. We utilized the Missouri Department of Conservation (1989) FishCalc89 and DisBCal89 programs with a Houston Instrument Hipad Plus digitizer to back calculate length at age for wild rainbow trout. We used 30 mm for rainbow trout length of squamation (Carlander). We developed linear regressions to describe the growth function. We counted the number of circuli to the first annulus to assess the possibility of the lack of formation of the first annulus. We estimated growth rates for each of the three study sections.

The growth data was tested statistically to see if they could be pooled. We compared the slopes and elevations of body-scale regressions for the three sections using analysis of covariance (Zar 1974). Where slope and elevation were not significantly different, we pooled the data.

We collected otoliths and scales from 18 wild rainbow trout. We determined ages from otoliths by reading whole structures under a binocular microscope using reflected light. Age determination followed methods described by Chilton and Beamish (1982). Ages from the two structures were compared to determine variation between scale and otolith aging techniques.

RESULTS

Population Sampling

Densities of game fish varied with habitat type. Densities were greatest in pool and run habitat (Table 2, Appendix B). HGR included pocket water pools with relatively high trout densities. The highest trout densities observed in zone 1 were in HGRs, areas anglers may not often fish. LGR and glide habitat contained low densities of trout. Most of the fish in these two habitat types were smaller than 150 mm. Wild rainbow trout densities increased from zone 1 upstream through zone 3 (Table 3).

Very low densities of bull trout, cutthroat trout and brook trout were present in all stations. Bull trout densities ranged from .036 fish/100 m^2 in section 3 to no fish observed in section 2 (Table 3). Cutthroat densities ranged from .004 to .009 fish/100m^2. We observed brook trout only in section 3, with high counts only associated with debris jams in station 15.

Mountain whitefish densities ranged from 0.76-1.15 fish/100 m^2 in our study sections (Table 3). Mountain whitefish densities were greatest in pool and run habitat types (Table 2).

In general, wild rainbow trout in the study area did not attain large sizes. Snorkel observations indicated 1% or less of wild rainbow trout exceeded 300 mm (Table 4).

Estimates of wild rainbow trout in the entire study area were similar for the two methods of calculation, but the stratification by habitat types provided narrower confidence limits. We estimated the population equalled 15,967 ± 1,791 (95% CL) wild rainbow trout using stratification by habitat in addition to snorkel station and river section. We estimated 14,030 ± 4,067 (95% CL) wild rainbow trout were present in the study area using snorkel counts for all habitats combined within the stations (traditional IDFG methodology). In every river section, the estimates using habitat stratification indicated slightly higher estimates, although the difference was small. Calculations of estimates using habitat units greatly reduces the variation within the primary stratification and, therefore, provides tighter confidence limits around the point estimate.

Table 2. Estimated fish densities (fish per 100 m^2) by habitat type for sample stations 1-5, 6-10, and 11-15, South Fork Payette River, 1992. Habitat classified as pool, run, high gradient riffle (HGR), low gradient riffle (LGR), and glide.

			Mean densities (fish/100 m^2)					
			Wild rainbow trout					
Stations	Habitat type	Number of stations	<150 mm	150-250 mm	250-300 mm	>300 mm	Total	WF
1-5	Pool	3	1.17	.46	.08	.03	1.74	3.3
	Run	3	1.18	.64	.07	.00	1.89	1.0
	HGR	3	1.12	.91	.09	.02	2.13	0.6
	LGR	3	0.37	.33	.02	.02	0.75	0.3
	Glide	3	0.40	.08	.00	.00	0.48	0.31
6-10	Pool	4	2.05	1.41	.44	.00	3.89	2.0
	Run	6	1.99	1.37	.19	.04	3.59	1.4
	HGR	4	0.71	.36	.05	.00	1.12	0.3
	LGR	1	0.81	.00	.00	.00	0.89	0.4
	Glide	1	0.09	.08	.00	.00	0.17	0.00
11-15	Pool	6	3.82	1.62	.10	.00	5.54	1.5
	Run	6	3.27	1.62	.30	.05	5.24	0.7
	HGR	4	1.97	1.24	.23	.02	3.46	0.6
	LGR	2	0.83	.25	.12	.00	1.20	0.6
	Glide	1	0.00	.36	.00	.00	0.36	0.24

Table 3. Densities of wild gamefish by river section for South Fork Payette River, 1992.

Section	Density (fish/100m^2)				
	Wild rainbow trout	Mountain whitefish	Brook trout	Bull trout	Cutthroat trout
1	1.33	0.93	0.00	0.004	0.004
2	2.57	1.15	0.00	0.000	0.009
3	3.79	0.76	0.36	0.036	0.007

Table 4. Percentage of wild rainbow trout exceeding 150, 250, and 300 mm in 15 snorkel stations in South Fork Payette River, 1992.

Section	Sample size	Percentage of fish exceeding		
		150 mm	250 mm	300 mm
1	304	40.5	4.6	1.0
2	286	43.4	8.0	0.7
3	521	37	5.8	0.6

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Creel Census

Anglers fished and estimated 16,010 (±2,085) h in the study area from May 23 through September 11, 1992 (Table 5). Total effort in hours was greatest in section 1 where the **six** fish bag limit and hatchery stocking occurred. Effort, expressed per surface area, was greatest in the less accessible section 3, but differences between the study sections were minimal. Annual fishing effort equalled 147 h/hectare/year in the wild trout zone and 135 h/hectare/year in the hatchery zone.

Rainbow trout comprised the majority of game fish caught in the study area (Table 6). Hatchery rainbow trout were only planted in section 1 and dominated the harvest **in** the lower section. Wild rainbow trout comprised 28% of the harvest in section 1 versus 88% and 95% in sections 2 and 3, respectively. Bull trout and cutthroat trout were seldom caught. An estimated 86 bull trout and 31 cutthroat trout were harvested during the entire census in all sections. Brook trout made up 3% of the section 3 harvest. This is the only area we observed them in while snorkeling. Other than rainbow trout, harvest estimates are characterized by small numbers with wide confidence limits.

Total catch rates ranged from 2.21 fish/h in section 1 to 1.62 fish/h in section 3 with a 1.85 fish/h average for the season (Table 6). Harvest rates were approximately three times higher in section 1 where hatchery rainbow trout stocking and six fish bag limit occur. Seventy-nine percent of the anglers interviewed in section 1 after a completed trip kept two or fewer fish (n = 58). Of those fishermen who had not kept **a** trout, 67% had caught and released at least one trout. In all areas, including section 1, anglers released a large proportion of their catch. Catch rates observed were well above the 0.5 fish/h catch rate goal for this stream (IDFG 1991).

Anglers harvested 4,934 (±1,340) hatchery rainbow trout, primarily in section 1 (Table 7). Based on pound counts, hatchery personnel stocked 8,950 hatchery put-and-take sized rainbow trout from Deadwood River to Tenmile Creek Bridge in 1992. Assuming pound counts were accurate, return to creel for hatchery fish equalled 55% (±15%), well above the statewide 40% goal (IDFG 1991). Anglers harvested an estimated 3,845 (±1,242) wild rainbow trout throughout the study area. Mountain whitefish, cutthroat trout, bull trout, and brook trout made up small proportions of the harvest.

South Fork Payette River anglers began harvesting wild rainbow trout at 150 mm. Wild rainbow trout harvested by anglers ranged from 150 to 300 mm with an average size of 206 mm (Figure 3). The size of wild rainbow trout harvested declined from zone 1 upriver to zone 3. Mean size equalled 217 mm in section 1, 201 mm in section 2 and 188 mm in section 3.

Based on interviews, 85% of anglers were Idaho residents. Anglers fished with bait most often (74%), followed by lures (12%) and artificial flies (14%). Average fishing trip equalled 1.7 h per angler (n = 172).

The condition factors for wild rainbow trout equalled 0.92, 0.89 and 0.87 in sections 1, 2, and 3, respectively.

Table 5. Estimated angler effort by section for South Fork Payette River, 1992. 95% confidence intervals in parentheses.

Section	Length (km)	Area (hectare)	Effort (h)		Effort (h/km)	Effort (h/hectare)
1	26	69.86	9,411	(±1,752	362	135
2	14	26.86	3,483	(± 839)	249	132
3	12	17.94	3,116	(± 757)	260	174
Total	52	114.15	16,01	(±2,08	308	140

Table 6. Species composition of harvest and catch rates from angler creel checks for South Fork Payette River, 1992.

[1] HRB = hatchery rainbow trout, WRB = wild rainbow trout, WF = mountain whitefish, CT = cutthroat trout, BT = bull trout, BK = brook trout.

		Species composition (%)[1]						Catch rate (fish/h)		
Section	n	HRB	WRB	WF	CT	BT	BK	Harvested	Released	Total
1	447	72	26	1	<1	1	0	0.80	1.42	2.2
2	59	6	88	3	1	1	0	0.25	1.46	1.7
3	55	0	95	3	0	0	3	0.29	1.33	1.6 2
				mean catch rate			=	0.45	1.40	1.8

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Table 7. Estimated harvest by species and section for South Fork Payette River, 1992. 95% confidence limit in parentheses.

Section	Estimated harvest by species[1]												Total harvest	
	HRB		WRB		WF		CT		BT		BK			
1	4,884	(±1,388)	1,943	(±863)	57	(±56)	22	(±30)	50	(±65)	0		6,952	(±1,782)
2	50	(±57)	1,225	(±760)	52	(±78)	9	(±21)	36	(±71)	0		1,370	(±841)
3	0		677	(±469)	13	(±24)	0		0		13	(±23)	703	(±576)
Total	4,934	(±1,340)	3,845	(±1,242)	122	(±99)	31	(±36)	86	(±96)	13	(±23)	9,034	(±2,062)

[1] HRB = hatchery rainbow trout, WRB = wild rainbow trout, WF = mountain whitefish, CT = cutthroat trout, BT = bull trout, BK = brook trout.

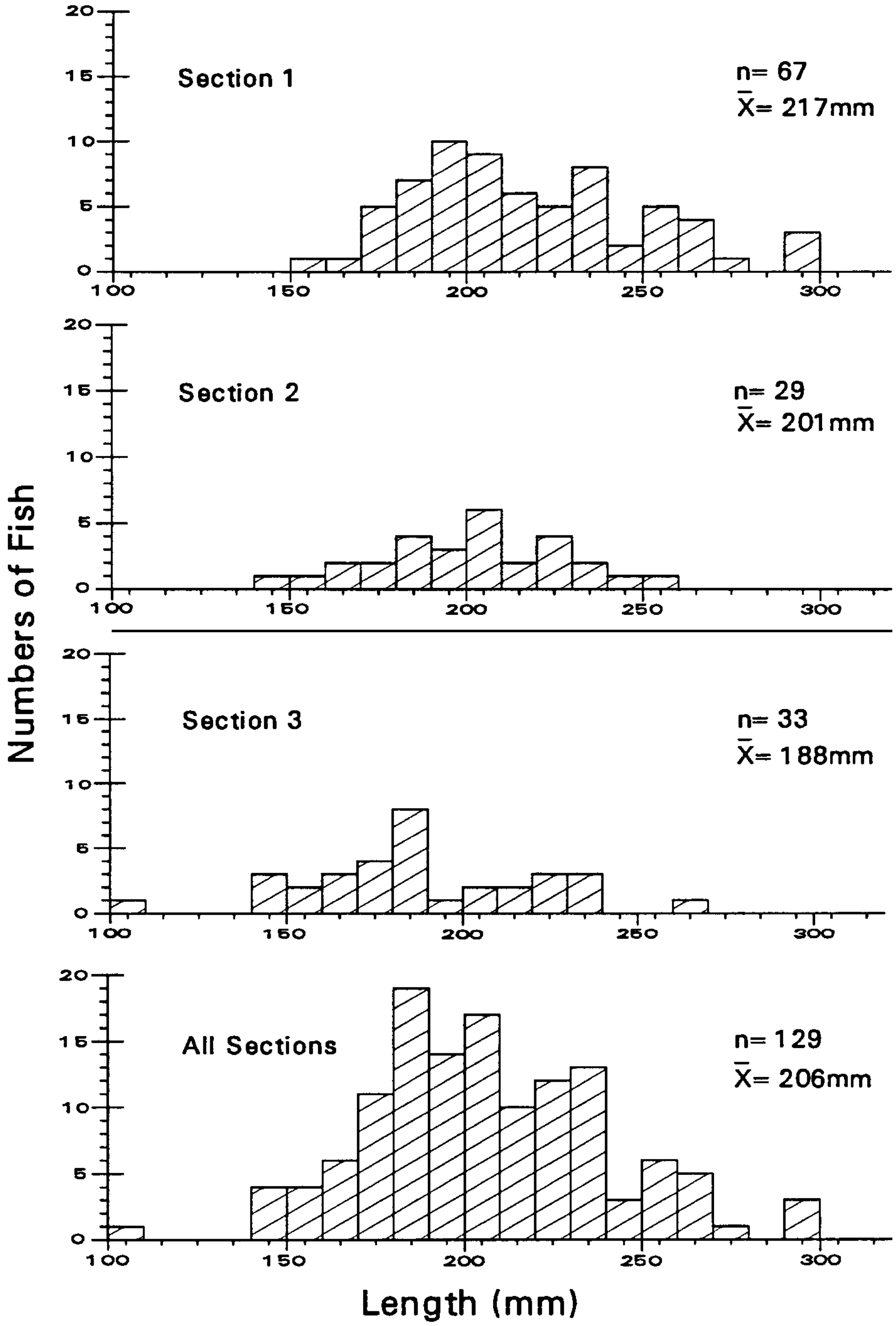

Figure 3. Length-frequencies of wild rainbow trout harvested by anglers in South Fork Payette River, Deadwood River to Grandjean, 1992.

Calculated yield for wild rainbow trout harvested by anglers was similar for all study sections. Anglers harvested an estimated 195.9 kg wild rainbow trout in section 1 for an average yield of 2.8 kg/hectare/year. Yields in both sections 2 and 3 equalled 2.5 kg/hectare/year.

Angler Attitudes

In general, awareness of the new wild trout regulation was low. Of 342 anglers interviewed, awareness of the regulation was 50% or less in all sections during interval 1 (Table 8). Anglers in sections 1 and 3 gained knowledge of the regulation as the season progressed. Section 3 had the highest percentage of anglers who knew about the new regulation. IDFG posted the wild trout zone (sections 2 and 3) with blue, 8 x 11 in, informational signs during July and produced **a** pocket brochure to educate anglers about the 1992 regulation changes. Despite these measures, only 47% of the anglers interviewed during the season knew about the regulation.

The majority of anglers interviewed in all sections indicated they would fish the South Fork Payette River in similar patterns as before regulation implementation (Table 8). Overall, 27% of the anglers in section 1 said they would fish the restricted regulation waters less compared to before implementation of wild trout regulations. The percentage of anglers in section 1 indicating they would fish less in the wild trout sections remained constant following interval I. No trend over time occurred in zones 2 and 3. Based on the anglers who said they were less likely to fish areas with a two fish bag limit, we estimated that potentially 27%, 16%, and 19% of South Fork Payette River anglers may be displaced by the regulation in sections 1, 2 and 3, respectively.

Exploitation

We estimated a total of 17,895 wild rainbow trout _>150 mm were present in the study area at the beginning of the fishing season (Tables 9 and 10). Estimated angling exploitation was similar for fish 150-250 mm in all three sections (Table 10). In section 1, estimated exploitation for wild rainbow trout 250-300 mm equalled 44%.

Fish first recruit to the sport fishery at approximately 150 mm, but all fish 150-200 mm are not fully recruited. Average angling exploitation rates of 25-30% for the 150-250 mm size range probably indicate higher rates on fish 200-250 mm. In the hatchery trout zone **(six** fish bag), wild rainbow trout are exposed to higher exploitation. In sections 2 and 3 angling exploitation is low (mean equals 4.9%) for wild rainbow >250.

Table 8. Angler awareness and attitudes towards wild trout, 2 fish bag limit, regulation on South Fork Payette River, 1992. Responses expressed as percentages of respondents.

			Are you aware of 2 fish limit		Given 2 fish limit, are you more or less likely to fish?		
Section	Interval	Sample size	Yes	No	More	Less	No change or no opinion
1	I	65	39	61	13	16	71
	II	51	45	55	14	33	53
	III	52	54	46	4	32	64
	IV	47	57	43	13	30	57
	Mean		48	52	11	27	62
2'	I	9	33	67	22	11	67
	II	17	41	59	64	2	24
	III	17	35	65	24	18	59
	IV	14	7	93	14	21	64
	Mean		30	70	33	16	51
3[a]	I	10	50	50	10	0	90
	II	31	55	44	29	36	36
	III	16	63	38	19	6	75
	IV	13	77	23	23	8	69
	Mean		60	40	23	19	58

[a] Sections 2 and 3 restricted to wild trout, 2 fish bag limit.

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Table 9. Surface area and estimated wild rainbow trout and mountain whitefish populations by river section for South Fork Payette River, 1992. Surface areas provided by Boise National Forest. Habitat classified as pool, run, high gradient riffle (HGR), low gradient riffle (LGR) or glide.

Section	Habitat type	Surface area (100 m²)	Wild rainbow trout					Mountain whitefish
			<150 mm	150-250 mm	250-300 mm	>300 mm	Total	
1	Pool	629	736	289	50	19	1,094	2,075
	Run	2,108	2,381	1,292	141	0	3,814	2,200
	HGR	3,725	4,172	3,390	335	75	7,935	2,570
	LGR	1,744	645	576	35	35	1,308	576
	Glide	1,575	630	126	0	0	576	488
Totals			8,564	5,673	561	129	14,927	7,909
2	Pool	653	1,338	920	287	0	2,539	1,338
	Run	1,925	3,831	2,638	366	77	6,912	2,850
	HGR	998	709	366	50	0	1,118	36
	LGR	467	378	0	37	0	415	224
	Glide	9	1	1	0	0	2	2
Total			6,257	3,918	740	77	10,986	4,450
3	Pool	39	149	63	4	0	216	62
	Run	1,118	3,657	1,812	336	56	5,860	783
	HGR	623	1,228	773	143	12	2,156	380
	LGR	288	239	72	75	0	346	179
	Glide	75	0	27	0	0	27	18
Total			5,273	2,747	518	68	8,605	1,422

Table 10. Estimated exploitation rates for wild rainbow trout by section and fish size for South Fork Payette River, 1992.

Fish size	Population Estimate[1]	Estimated harvest	Exploitation
		Section 1	
150-250 mm	7,144	1,566	21.9%
>250 mm	1,045	377	44.0%
		Section 2	
150-250 mm	4,994	1,181	23.6%
>250 mm	856	44	5.9%
		Section 3	
150-250 mm	3,250	654	20.1%
>250 mm	606	23	3.8%

[1] Population estimate equals snorkel estimate plus angler harvest May 23 through August 14.

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Biomass

The length-weight relationship for wild rainbow trout is described by the equation: $W = 1.0 \times 10^{-5} \times L^{2.98}$ (r^2=.92). We estimated a mean length of 212 mm using the midpoint of the length groups from snorkel estimates and the observed number of fish in the three sections. Using the equation above, the estimated average weight equalled 85.36 g/fish. We estimated the mean biomass for the entire study section equalled 7.2 kg/hectare.

Age-Growth Analysis

Scales were collected and analyzed from 76, 12, and 53 wild rainbow trout in sections 1, 2 and 3, respectively. Fish ranged from 150-310 mm total length and encompassed age groups 1 through 4. We encountered extensive variability in age of similar sized individual fish (Figure 4). Many scales exhibited evidence of regeneration.

Calculated body-scale regressions equalled $Y = 102.0994 + 1228.4537(X)$ (r^2 = .49) for section 1 and 2 and $Y = 47.1371 + 1775.1702(X)$ (r^2 = .72) for section 3. Trout grew to similar average lengths at age 1 in both sections (Table 11). Growth for age 1 rainbow trout was similar in both areas but growth in section 3 dropped off after age I (Table 10). T-tests indicate no significant differences ($P < .05$) in length for age 1 and age 3 rainbow between sections 1 + 2 combined versus section 3. Age 2 fish length were significantly different ($P < .05$) between the two sections with faster growth in sections 1 + 2. Lengths at age 4 were based on sample sizes of four and one fish for sections 1 and 2 and section 3, respectively. The small sample size precludes comparisons.

Circuli counts from wild rainbow trout ranged from 7-18. Of the scales examined, 25% in zones 1 and 2 and 28% in zone 3 had circuli counts of 13 or more.

We aged both otoliths and scales for 18 fish. Estimated ages were not in agreement in 39% of these fish (Figure 5). Coupled with high circuli counts to the first annulus, this information suggests we underaged trout from the South Fork Payette River. This information may help explain the occurrence of a 180 mm fish aged as 1+ and 250 and 290 mm fish aged as 2+ (Figure 4).

DISCUSSION

Population Sampling

The suitability of snorkeling for assessing population numbers has received much recent attention. Hankin and Reeves (1988) suggest snorkeling underestimates fish populations when compared to electrofishing. Petrosky and Holubetz (1987) indicate snorkeling will yield higher estimates than

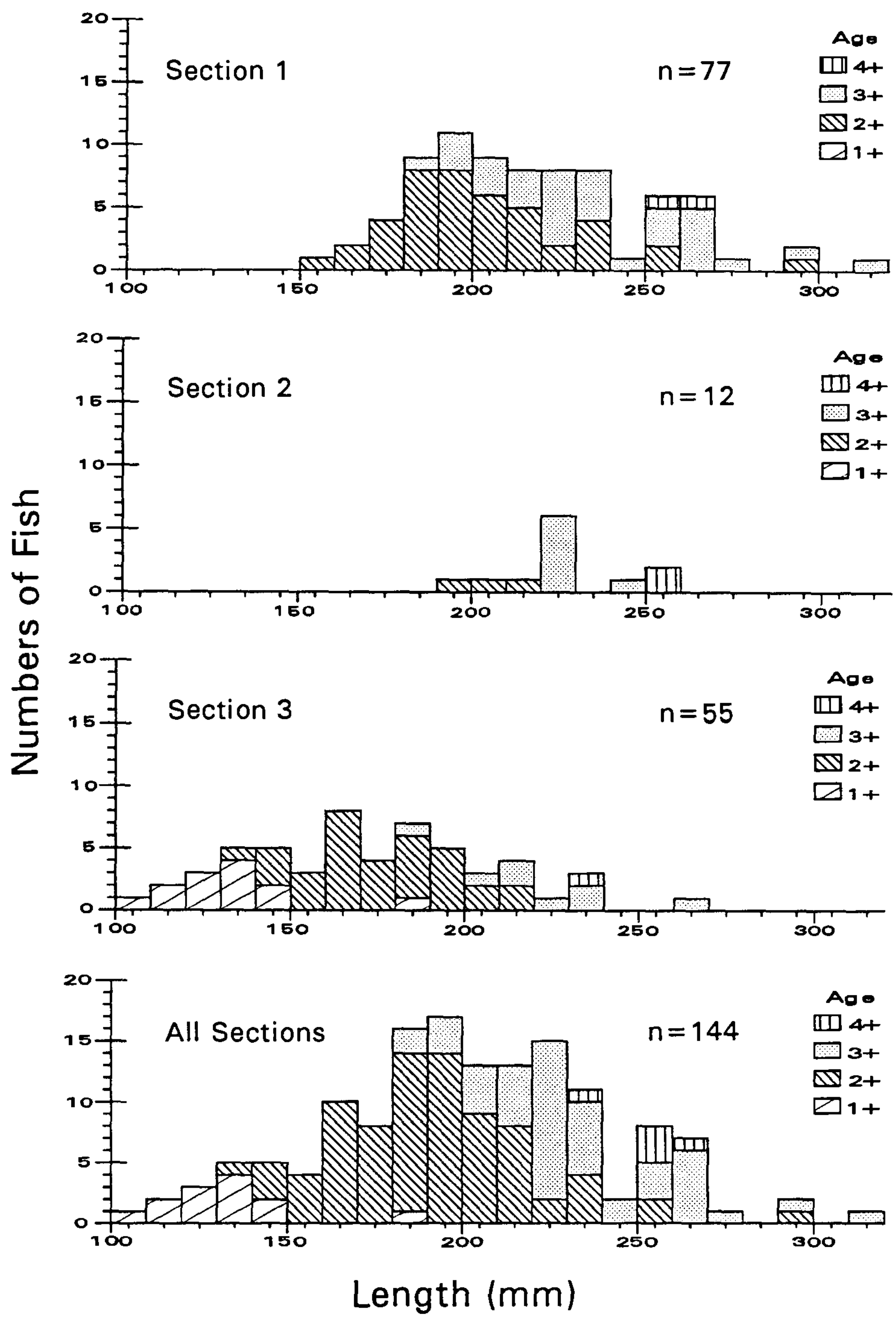

Figure 4. Length-frequency distribution by age class for wild rainbow trout, South Fork Payette River, 1992. Age determination from scale analysis.

Table 11. Mean calculated total lengths and increments of growth for wild rainbow trout in South Fork Payette River, 1992.

Age class	Number of fish	Calculated total length at each annulus (mm)			
		1	2	3	4
		Sections 1 + 2			
0	0				
I	0	0			
ZI	45	104	156		
III	39	93	143	189	
IV	4	90	143	189	233
Number of fish		88	88	43	4
Wt. grand average		98	150	189	233
Mean growth inc.		98	52	46	44
		Section 3			
0	0				
I	13	97			
II	31	99	142		
III	8	96	138	184	
IV	1	81	127	169	204
Number of fish		53	40	9	1
Wt. grand avgerage		98	141	182	204
Mean growth inc.		98	42	45	35

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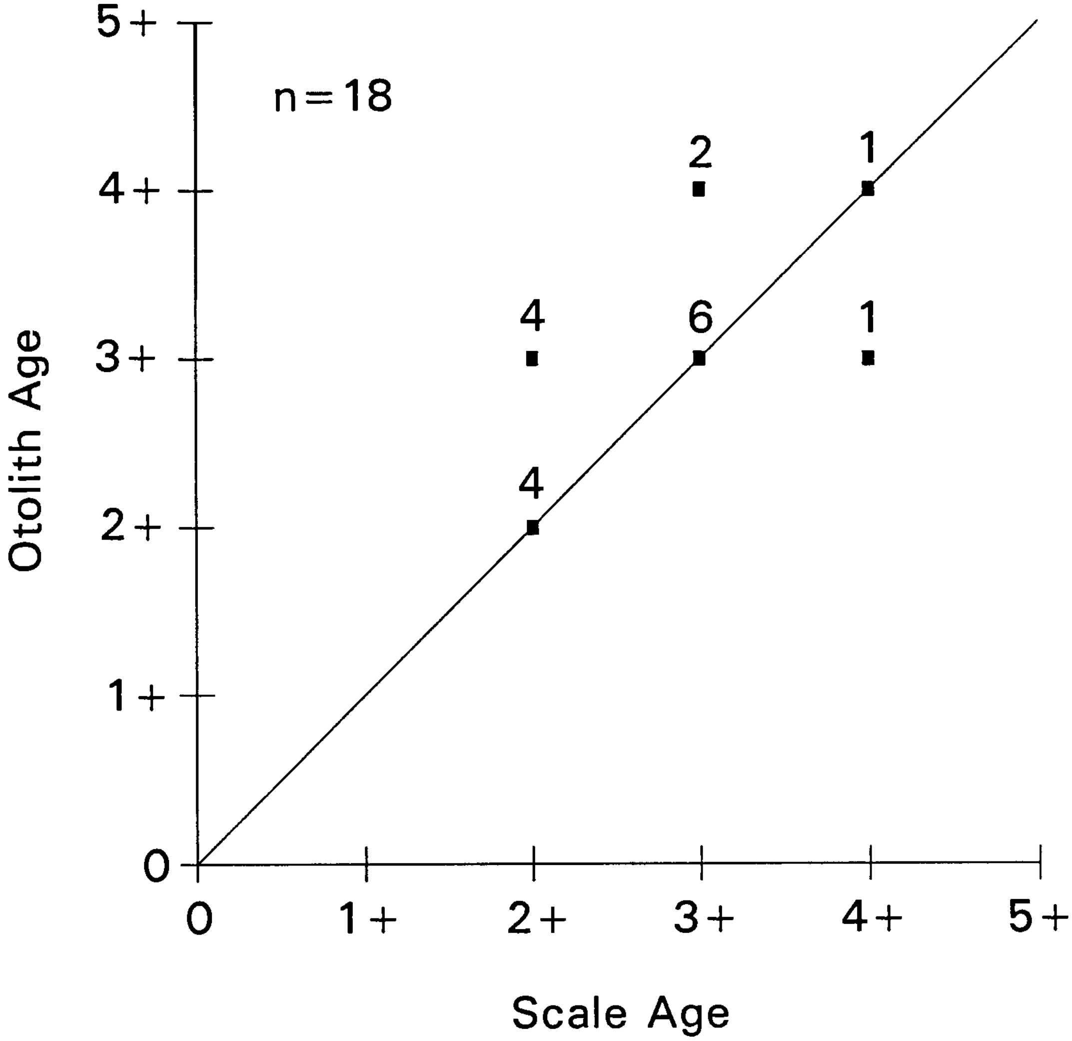

Figure 5. Comparison of age determinations using scales and otoliths for wild rainbow trout, South Fork Payette River, 1992. Numbers above data points denote numbers of fish aged at that point.

electrofishing in low conductivity waters. Zubick and Fraley (1988) report snorkeling is as accurate as mark-recapture estimates providing divers have adequate visibility. Visibility in South Fork Payette River study sections exceeded 8 m and teams of two to four divers could adequately view the entire sample transects. Most transects contained only small amounts of woody debris or undercut bank habitat which can lead to underestimating fish numbers by snorkel techniques (Northcote and Wilkie 1963; Shepard and Graham 1983). We are uncertain how accurate our snorkeling estimate is, but it was the only method available.

We did not conduct multiple counts in each transect and therefore cannot estimate the precision of our snorkel counts. Using multiple replicates, Schill and Griffith (1983) estimated team snorkel counts provided good precision in the Yellowstone River.

Griffith (1981) reports snorkeling is effective for determining age frequencies from size frequencies. Errors in our classification of wild rainbow trout, especially near the 150 mm and 300 mm size breaks, would affect the population estimates and ultimately the exploitation estimates. The lack of angler harvest of fish over 300 mm indicates we overestimated size for large fish. Therefore, our snorkel estimates for fish >300 mm should be used with caution.

Our density estimates were strongly influenced by habitat types within stations. We made separate counts of fish by habitat type to improve the reliability of expanded population estimates (Hankin and Reeves 1988). Sampling by habitat units takes advantage of correlation between habitat units and fish numbers and reduces variance of expanded estimates (Hankin 1984). Snorkel transects were systematically selected and varied in length to include at least three habitat types. Unless densities are believed to be cyclic within a river, Hankin (1984) suggests systematic sampling which included separate mapping and fish counts are superior to random selection of transects from area maps.

We located the five snorkel transects in the upper one half of section 1. Increased water depths in the lower portion of section 1 prevented divers from being able to accurately observe and count schools of fish. We were also limited in numbers of divers available. By not sampling transects throughout section 1, we possibly biased our estimate of total fish available for exploitation. If our sampling resulted in underestimates of wild rainbow densities in section 1, then we underestimated total population and overestimated angling exploitation for this reach.

We assume the mapping information provided by the U. S. Forest Service is accurate. The data was collected during 1991 and only every 10th transect was actually measured. Visual estimates for other transects were adjusted from the detailed measurements (Hankin and Reeves 1988). Water levels during mapping 1991 were likely different in 1992 when we made snorkel observations. The detailed mapping provided by the U.S. Forest Service is likely to be more accurate than using a map wheel on topographic maps and the limited habitat data collected during snorkel surveys.

We observed higher densities of wild rainbow trout in the South Fork Payette River than tributaries to the Boise River (Rohrer 1989 and 1990) and the Middle Fork Payette River (Mabbott and Holubetz 1990)(Table 12). For central Idaho streams managed with general regulations, only the Big Wood River had higher densities (Table 12). Our South Fork Payette River density estimates remained consistent with prior snorkel observations in 1987 through 1990 (Mabbott and Holubetz 1989 and 1990).

We observed few large wild rainbow trout in our snorkeling stations. Less than 1% of wild rainbow trout were classified as >300 mm. Rohrer (1989 and 1990) observed an average of 4% (range 0-13%) and 1.4% (range 0-3.4%) rainbow trout greater than 300 mm in North and Middle forks Boise River, respectively. He attributed the greater percentage of large fish in the North Fork Boise River to limited access.

We counted very few bull trout in our transects. Fraley and Shepard (1989) indicate snorkel methods to count bull trout are not reliable due to the cryptic coloration and close proximity bull trout maintain to substrate. Schill (1991) suggests minimal difference between electrofishing and either day or night snorkeling techniques in surveying bull trout. During snorkeling, water temperatures ranged from 13-19°C. Fraley and Shepard (1989) indicate bull trout move out of streams when temperatures exceed 15°C. Also bull trout adults would be expected to be in tributaries spawning during our observation period. The combination of warm temperatures, spawning movement and use of snorkeling as a counting technique possibly contribute to low bull trout densities. If not, then the populations in the South Fork Payette River are very depressed. Rohrer (1990) also observed low densities of bull trout in the Middle and North forks Boise River. Bull trout populations are under consideration for listing as threatened and endangered species as a result of population declines in the northwestern United States. Additionally, brook can hybridize with bull trout producing a sterile offspring. The brook trout in section 3 may represent a threat to bull trout populations in the drainage.

Cutthroat trout were found in very small numbers throughout the study area. Behnke (1979) states cutthroat trout were not native to this portion of the Snake River drainage. Behnke believes resident redband forms of rainbow trout occupied the same niche as cutthroat trout. The few cutthroat trout present probably originate from hatchery releases into high mountain lakes within the drainage.

Population estimates using habitat stratification provided tighter confidence limits compared to counts without regard to habitat type. Hankin and Reeves (1988) suggest by stratifying fish counts by habitat type, variation of counts within a given habitat can be reduced. These improved counts require more field effort to complete but appear worth the effort.

Table 12. Densities of wild rainbow trout in selected central Idaho waters.

Stream	Source	Densities (fish/100 m^2) Mean	Range
South Fork Payette River	Current Study	2.56	1.33-3.79
South Fork Payette River	Mabbott-Holubetz 1988	2.17	0.00-4.40
	Mabbott-Holubetz 1990	1.18	0.04-1.90
	Mabbott-Holubetz 1991	3.23	1.90-5.70
Middle Fork Boise River	Rohrer 1988	0.93	0.39-2.07
North Fork Boise River	Rohrer 1987	0.85	0.21-1.20
Big Wood River	Thurow 1986	3.67	1.68-6.11
Big Lost River			
East Fork	Elle-Corsi 1986	1.30	0.95-1.64
North Fork	Elle-Corsi 1986	2.65	

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Creel Census

The effort levels on the South Fork Payette River are similar to other general regulation waters in central and north Idaho rainbow trout streams. Effort levels in southern Idaho streams are generally much higher (Schill 1992) (Figure 6).

Hatchery rainbow trout return to the creel was well above the 40% statewide goal. Some hatchery trout were caught in the lower reaches of the wild trout zone.

Snorkel counts indicate 1% or less of the trout present exceed 300 mm, but anglers we interviewed did not catch any of this size class. Prior census information indicates a low angler catch of rainbow greater than 300 mm. In 1980, 3.3% of fish checked during a structured census exceeded 300 mm (Reid and Anderson 1981) and in 1970 7% of fish checked exceeded 300 mm with the largest being 400 mm (IDFG 1971). During the 1980 census, wild rainbow trout mean length equalled 225 mm compared to 217 mm during this study. The above data suggest the size of wild rainbow trout has declined in the past two decades. The 1970 and 1980 census data included harvest from the entire river downstream to Banks, however. Larger rainbow trout may reside in the segments below Lowman not censused in 1992. Virgil Moore (IDFG, personal communication) caught a wild rainbow trout about 400 mm below Garden Valley in 1992. The lack of wild rainbow trout >300 mm harvest in this census and in the past again indicates the possibility that we overestimated size in our snorkel observations.

The potential to grow and recruit larger trout to the fishery is a key question for the South Fork Payette River fishery. Historic anecdotal information indicates at least portions of the South Fork Payette River did produce larger fish. IDFG (1971) indicated checking a 400 mm wild rainbow trout. Eugene Brock was a Forest Service Ranger in Lowman for 20 years. He recalls catching rainbow trout up to 20 in (500 mm) but no actual documentation for such a catch **exists**. A 1968 newspaper photo from the Idaho Statesmen shows a winter angler with 12 trout which appear to be large rainbow and bull trout. This information suggest sections of the South Fork Payette River can produce larger fish.

The wild trout regulation (two fish bag) will not likely result in a large increase of bigger fish without voluntary release of large proportions of fish caught by anglers. Based on interviews in section 1, 67% of anglers who completed fishing for the day kept two or fewer fish. This data suggests in the wild trout zone the two fish bag limit, without regard to size, only protects up to 33% of the potential harvest. But 67% of the section 1 anglers who kept no fish had caught and released one or more fish. A high voluntary release rate is an important step to successful two fish wild trout regulations.

Total catch rates exceed 1.6 fish/h in all sections, well above the goal of 0.5 fish/h for the South Fork Payette River. Reid and Anderson (1981) observed harvest rates ranging from 0.6-3.0 fish/h. Those rates were higher than the present study (0.25-0.80 fish/h). The reduced catch rate for fish kept in 1992 is partially due to reduced bag limits. During 1992, anglers released a high

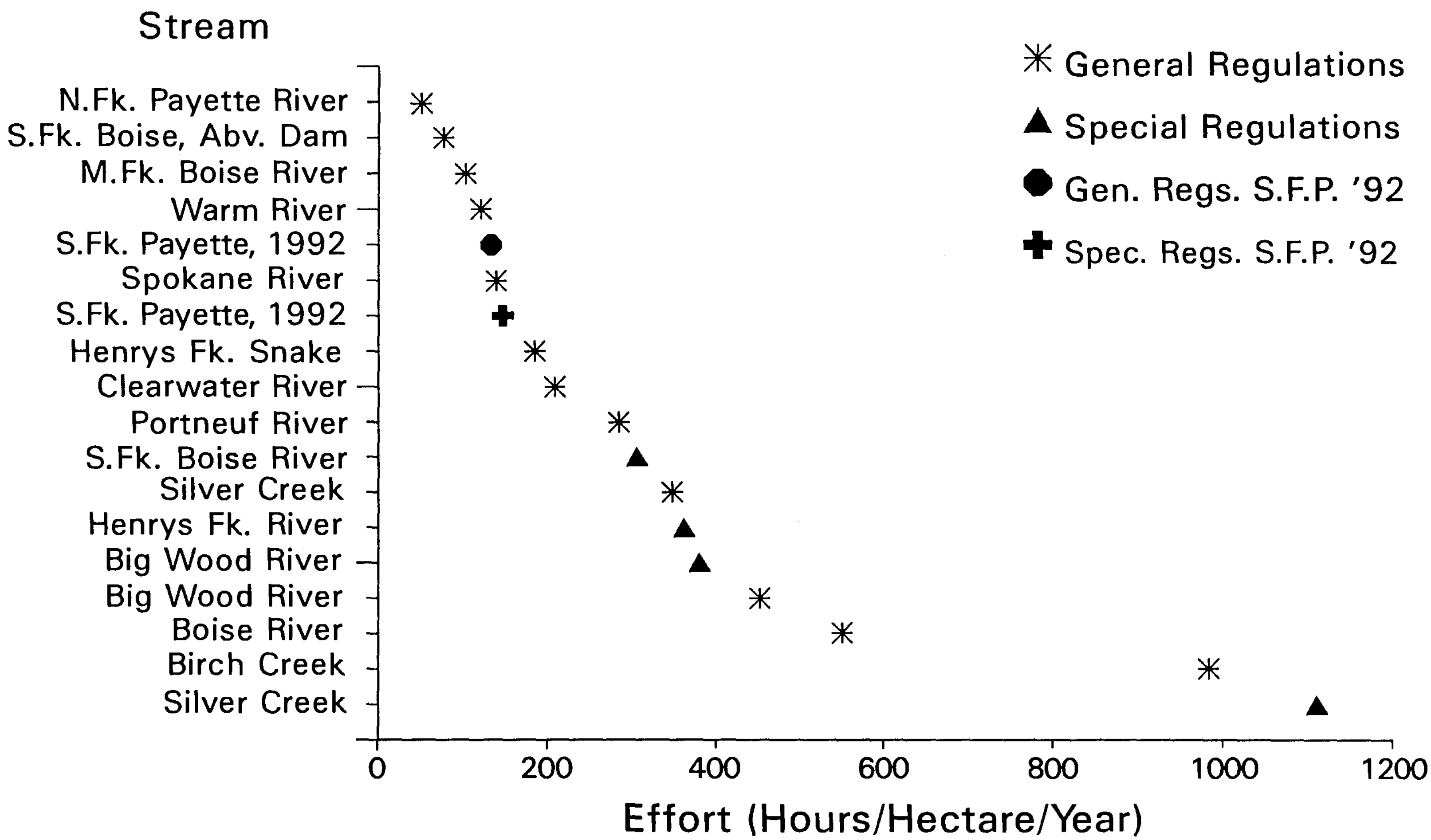

Figure 6. Estimated annual angler effort (hours/hectare/year) for wild rainbow trout fisheries in Idaho. Comparison with South Fork Payette River general and restricted harvest zones, 1992.

portion of the fish caught, both in the general six fish regulation zone and in the wild trout zone. The high release rates may be partially due to the abundance of small trout present in the population.

Wild rainbow trout had a condition factor of 0.87-0.92, lower than other central Idaho streams. Rohrer (1989) calculated a condition factor of 1.0 for Middle Fork Boise River. Angradi and Contour (1987) reported wild rainbow trout had a condition factor of 1.16 for Henrys Fork Snake River and Reihle et al. (1989) reported 1.15 for Silver Creek in Idaho.

We conducted the census from May 23 to September 11. By ending the census September 11, we underestimated the total effort and season-long harvest since stream fishing season in Idaho extends to November 30. Reid and Anderson (1981) estimated 3% of the effort on the South Fork Payette River occurred September to October 10 (census period July 19 to October 10). Thurow (1987) estimated 9% of the effort on the Big Wood River occurred after September 20 (census period June 14 to November 14). The underestimate is projected at 5 to 15%.

Despite potential data limitations, the snorkel counts and creel census represent the best collection methods available and are comparable to methods of prior studies. Based on review of the literature, we believe the data collected provide an accurate indication of the fish populations and fishery present in our study section of the South Fork Payette River.

Angler Attitudes

Over half the anglers we interviewed did not know of the 1992 wild trout regulation change for the South Fork Payette River. Anglers in section 3 during intervals III and IV had an improved awareness of the regulation. Signing of the wild trout zone occurred in July, well after the season began. The use of larger, permanent signs placed prior to the season may have improved angler awareness.

A minority of anglers (16-27%) said they were less likely to fish the restricted harvest waters. This percentage was higher in section 1 versus sections 2 and 3, however, and may indicate some displacement occurred during the season. The percentage of anglers in section 1 indicating they would change fishing locations doubled from interval I to II, remaining constant the rest of the season. This may represent a shift in area selected by anglers once they discovered the regulation changes. We cannot adequately assess displacement from sections 2 and 3 because we do not have angler profiles prior to implementation of the wild trout regulations. Overall, the wild trout regulation on the South Fork Payette River appears to provide a choice of regulations for anglers to select in a small geographical area.

Exploitation

Exploitation rates for the wild rainbow trout size group 150-250 mm were an estimated 20.1 to 23.6% in all sections. We believe this is an underestimate for trout on the upper end of the size group. The 150 to 200 mm are only partially available to the sport fishery gear. This results in an overestimate of exploitation on 150-200 fish and an underestimate of exploitation on 200-250 mm fish.

Exploitation rates for wild rainbow trout >250 mm were 44% in section 1 versus 5% or less in sections 2 and 3. The densities of fish in section 1 are lower than sections 2 and 3. Rieman and Apperson (1989) indicated exploitation can increase as densities decrease. This may help explain the higher exploitation rates in section 1 even though effort and yield, based on surface area, are similar in all sections.

We did not calculate confidence limits for our exploitation estimates because of the methods used to derive them. Our estimated exploitation for hatchery trout in section 1 equalled 55% (±15%). The wild rainbow trout size group >250 mm corresponds to the size of hatchery trout. The estimated exploitation of 44% falls within the lower confidence limit for hatchery rainbow trout, lending some credence to the high estimate for wild rainbow trout in section 1.

The difference in regulations may effect exploitation rates in the study area. Despite a lack of awareness of the restricted harvest regulations, many anglers released most or all of their fish in sections 2 and 3. The shift of harvest oriented fishermen away from sections 2 and 3 may have contributed to the large difference in estimated exploitation rates.

Our value for exploitation is a partial underestimate because we have no estimate for effort and harvest from September 12 through the end of the fishing season, November 30.

Biomass

Biomass provides an accurate measure of the population in a waterbody using size and weight of fish. It provides a more meaningful value than densities alone when comparing different waters or sections of the same stream or lake. This is because large numbers of small fish may not equate to a quality fishery with fewer and larger fish. Biomass incorporates a measure of size into the comparisons.

The biomass estimate for our study areas was 7.2 kg/hectare. This value represents the lower range of values we found for Idaho streams (Figure 7). It is similar to central and north Idaho streams with rainbow or cutthroat trout populations managed under general regulations, and far below the values for south

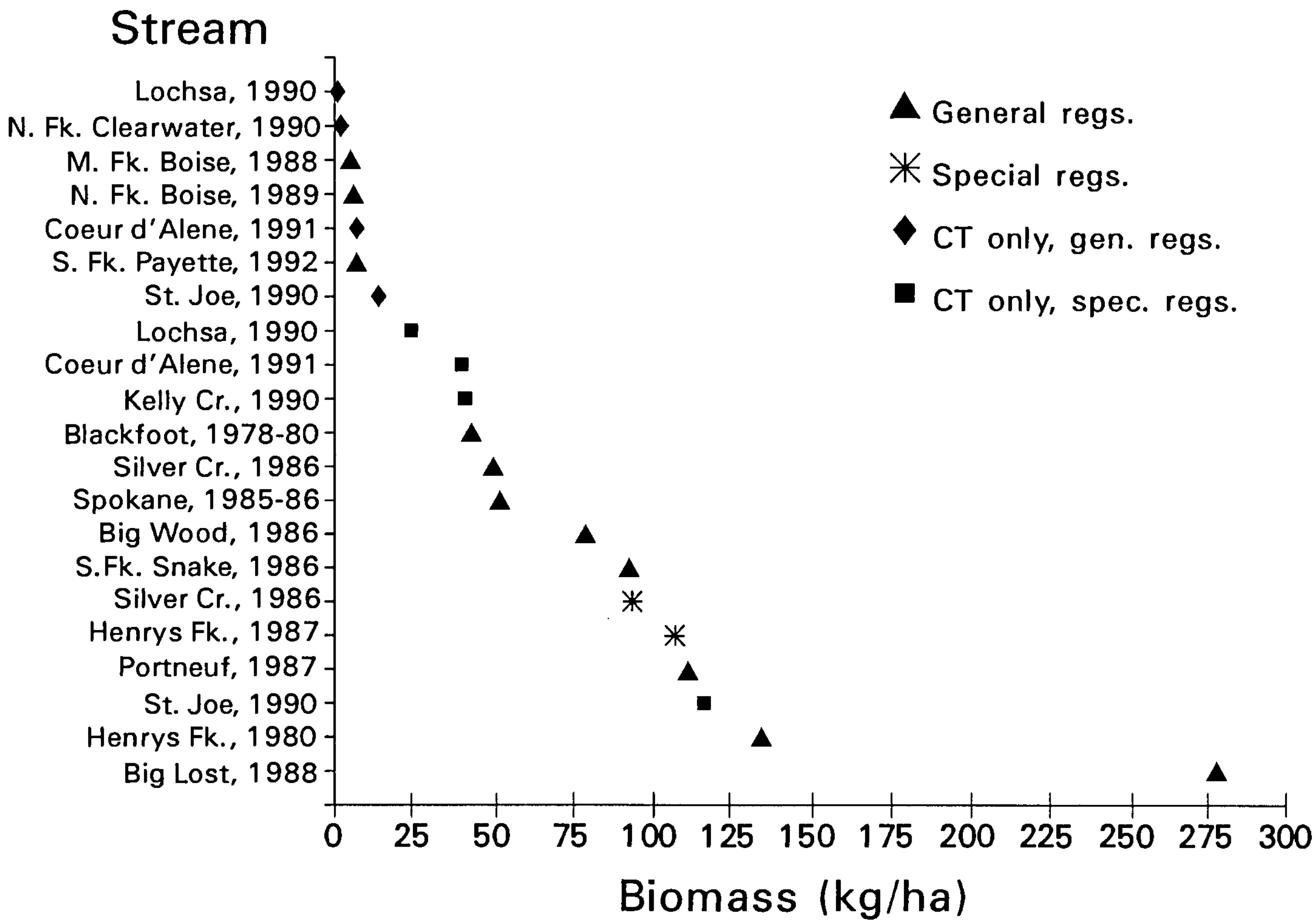

Figure 7. Estimated biomass (kilograms/hectare) for wild trout fisheries in Idaho. Year indicates year of study. See Appendix C for references.

Idaho streams. Habera and Strange (1993) suggest biomass levels of 20-60 kg/hectare is relatively low for Appalachian streams. Bennett (1989) cites a number of studies with biomass estimates of 80-150 kg/hectare.

Age-Growth Analysis

Growth rates for wild rainbow trout in the South Fork Payette River are lower than many other Idaho streams (Schill 1991) (Table 13). The conductivity of the South Fork Payette River was 80 uomhs and compared with other systems, ranks fairly low in productivity. Due to the slow growth rates, these fish likely undergo an extra year of natural mortality before they enter the fishery (age 2+) compared to other fisheries.

The scales were difficult to read and the potential for bias in our age analysis seems high. First, our sample was not adequately represented by all size classes of fish. In section 3 we had only one age 4 fish and in sections 1 and 2 we had four fish aged 4. Also in section 1 and 2 we had no age 0+ and few age 1+ fish in the sample. Thus, there is possible unknown bias from small sample sizes. The second bias is the possible underestimate of age by one year in 39% of our sample. Lorson and Marcinko (1990) reported a 33% disagreement between scales and otolilths for brown trout Salmo trutta and noted scales underestimated age compared to otoliths in free-stone streams.

We observed high circuli counts to the first annulus (13 or more) in approximately 25% of our sample. These may occur when the fish fail to lay down a first-year annulus (Lentch and Griffith 1987; Mallet 1963). One possible correction is to add a year to scales with a high number of circuli to the first annulus (Lewensky and Bjornn 1983; Mallet 1963). If we used an adjusted (higher) estimate for age incorrectly, however, an underestimate of natural mortality and overestimate of potential benefits from regulations would result.

We reread selected scales with 15 to 18 circuli to the first annulus and could not detect an annulus we had missed in original determinations. Additionally, we had several scale and otolith readings which agreed as to the total age for samples with 16 to 18 circuli. The lack of a pattern for the scales with high circuli counts prior to the first annuli caused me to make no changes based on number of circuli. If we did underestimate the age of our fish, the population growth rate is even slower than we calculated. Our scale analysis should be regarded with caution due to the difficulties in analysis but growth does appear slow.

Potential Population Response

Perhaps the best evaluation of wild trout potential for the Payette River system lies in general comparisons with other similar waters. Rohrer (1989) observed lower fish densities, few wild rainbow over 300 mm, and high exploitation in the Middle Fork Boise River, a system with similar conductivity and size compared to the South Fork Payette River. In 1990, IDFG placed a two

Table 13. Comparison of back-calculated total lengths at each annulus for rainbow trout from selected Idaho waters.

Location	Length at age					Conductance (umhos)	Reference
	1	2	3	4	5		
South Fork Payette River	98	150	189	233	-	80	Present study
Henry Fork Snake River Buffalo River to Last Chance	129	211	297	369	458	128	Rohrer (1983)
South Fork Boise River	135	210	300	357	414	118	Mate (1977)
Big Wood River	100	176	279	358	461	230	Thurow (1987)
Silver Creek	112	208	280	349		306	Thurow (1978)
Middle Fork Boise River	71	156	227	287	338	101	Rohrer (1990)

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fish, none under 350 mm (14 in) bag limit on the Middle Fork Boise River. The fish population response on the Middle Fork Boise River since 1990 should provide insight to as yet unanswered questions on potential population response on the South Fork Payette River.

The lower section of the South Fork Payette River may have better growth potential. Data collection for fish populations and growth rates should be collected on this section of the Payette to compare with our study area and the Middle Fork Boise River. The South Fork Payette River is a low to moderately productive system. Fishing harvest, especially on large fish, may limit potential to the wild rainbow trout populations. Several critical questions remain. How large will wild rainbow trout grow in the South Fork Payette River? Will a minimum size limit combined with the two fish bag limit protect fish to a larger size before they are lost to natural mortality? Schill (1992) showed even modest levels (20%) of exploitation on slow to medium growing populations will adversely effect population size structure. We should collect more otoliths and scales to develop the necessary correction factor for age-growth analysis. With good information we could model other types of regulations to answer questions regarding how large fish will grow in the South Fork Payette River.

RECOMMENDATIONS

1. Continue stocking hatchery trout in section 1 (Deadwood River to Eightmile Creek) due high return (55%) to creel and to provide a local alternative for harvest-oriented fishermen.

2. When possible, snorkel estimates should be stratified by habitat type to improve the accuracy of the population estimates.

3. Improve angler awareness of the regulations via education efforts. Increase number of signs along the river corridor. Signs should be posted well ahead of the season.

4. Evaluate Middle Fork Boise River wild trout regulations implemented in 1990. The Middle Fork Boise River has similar fish population attributes to South Fork Payette River and will provide comparison of the potential increase in trout numbers and size in the South Fork Payette River.

5. Collect scales and otoliths from Middle Fork Boise and upper and lower reaches South Fork Payette rivers for age-growth validation and to evaluate regulation potential.

6. Conduct population sampling in South Fork Payette River below Deadwood River to determine population densities and size of wild trout.

7. Collect length and weight samples for all population estimates conducted statewide. Calculate biomass estimates as a basis for comparison of populations within regions and the state.

ACKNOWLEDGEMENTS

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APPENDICES

Appendix A. Descriptions of the 15 snorkel stations with reference to section boundaries for South Fork Payette River, 1992.

Station	Description
Site 1.	Approximately 1/4 mile above Meadow Creek, 2nd undeveloped campground above Archie Creek. Massive pool below camping area is start.
Site 2.	Lower end of Helende flat. Starts just below helipad and continues past big natural slide on far bank.
Site 3.	Site begins at high gradient riffle exactly at mouth of Helende Creek (dry this year) and ends in large pool with big bedrock cliff on right bank. Site is bordered by private cabin with gate just above Helende Creek.
Site 4.	This is Holubetz site 3. Located between 5-mile and Kettle Creek approximately 150 m above Lowman fire information placards. Look for guardrails, only ones in area.
Site 5.	Drive across 10-mile bridge and go downstream on county landfill road approximately 2/3 mile, pull off to small primitive camping area and park opposite of red-roofed cabin on north bank.
Site 6.	Start exactly at mouth of Little 10-mile Creek and go upstream.
Site 7.	Measure up 115 m above Cassner Creek (uppermost fork, even if dry) and start at the run.
Site 8.	Approximately 1 mi below Warm Springs Guard Station and approximately 1/3 mi below River mile 128 on tops. Site begins in massive pool with rock point along south shore, popular fishing. T9n, R9E, S12, could be hard to find.
Site 9.	Go approximately 150 m above big cascades above Chapman Creek. Site begins in pool.
Site 10.	Between mileposts 92 and 93 on main highway. Site is along second parking pulloff below milepost 93 sign (not including road to primitive camping at the sign).
Site 11.	Large pool at mouth of Canyon Creek is middle of station and also Holubetz site 1. Measure down 93 m from bottom of this pool to get start of station.
Site 12.	Station ends at mouth of Camp Creek. Measure down 295 m to start if photos confusing. This station takes awhile to get to and is best accessed via a timber road.
Site 13.	First access road below Wapiti Creek Bridge. Start even with the big pine tree near campsite and vehicle parking.
Site 14.	Station ruins past Sacajaweh Hot Springs.
Site 15.	Located between Grand Jean and Trail Creek Campground. Take loop road to farthest point downstream and park near stream. Station ends near here and starts below at bottom of huge debris jam/pool. This jam will not move until major hydraulic event.

Appendix B. Snorkel station dimensions (m), habitat (m^2) and fish counted for South Fork Payette River, 1992. Habitat types equal pool run, high gradient riffle (HGR), low gradient riffle (LGR) and glide.

					Fish counts								
					Wild rainbow trout								
Station	Habitat type	Length	Width	Area (m^2)	<150 mm	150-250 mm	250-300 mm	>300 mm	**HRB**	WF	**BK**	CT	**BT**
1	Pool	47.0	30.0	1,410	23	10	2	1	4	26	0	0	1
	HGR	45.0	255.0	1,148	25	21	4	1	0	8	0	0	0
2	Glide	106.5	34.1	3,636	3	2	0	0	4	9	0	0	0
	Run	90.0	24.4	2,196	4	0	1	0	7	15	0	0	0
	LGR	52.0	28.7	1,492	10	4	0	0	0	4	0	0	0
3	HGR	98.0	21.5	2,107	25	7	0	0	1	18	0	0	0
	Glide	39.0	24.9	971	6	2	0	0	0	4	0	0	0
	Pool	46.0	22.7	1,044	10	3	0	0	2	48	0	0	0
4	Run	87.0	16.2	1,409	23	11	3	0	2	32	0	0	0
	HGR	71.5	19.4	1,387	2	14	0	0	2	6	0	0	0
	LGR	85.0	24.9	2,117	3	3	0	0	0	3	0	0	0
5	Glide	40.0	35.5	1,420	15	1	0	0	0	6	0	0	0
	LGR	34.0	27.3	928	4	8	1	1	0	8	0	0	0
	Pool	17.0	21.4	364	0	0	0	0	0	19	0	1	0
	Run	81.0	21.4	1,733	28	23	0	0	0	11	0	0	0
6	Glide	46.4	25.0	1,160	1	1	0	0	0	0	0	0	0
	Pool	32.6	18.6	606	6	4	3	0	0	19	0	0	0
	Run	40.0	15.1	604	5	7	1	0	0	6	0	0	0
7	Run	67.0	16.3	1,089	3	10	2	1	0	16	0	0	0
	HGR	46.5	18.9	879	0	2	0	0	0	2	0	0	0
	Pool	42.0	17.3	725	17	9	3	0	0	5	0	1	0
8	Pool	45.0	17.4	783	15	14	5	0	0	19	0	0	0
	HGR	29.0	17.7	513	9	1	0	0	0	3	0	0	0
	LGR	60.0	20.6	1,236	10	0	1	0	0	6	0	0	0

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Appendix B. (continued)

					Fish counts								
					Wild rainbow trout								
Station	Habitat type	Length	Width	**Area** (m^{2}1	<150 mm	150-250 mm	250-300 mm	>300 mm	**HRB**	WF	BK	CT	BT
9	Pool	26.0	14.5	377	13	8	0	0	0	0	0	0	0
	Run	18.0	11.7	211	8	6	2	1	0	3	0	0	0
	HGR	22.5	14.1	317	3	0	1	0	0	1	0	0	0
	Run	50.0	14.9	745	9	14	2	0	0	20	0	0	0
10	Run	34.1	15.7	535	13	12	1	0	0	2	0	0	0
	HGR	16.3	15.4	252	2	4	0	0	0	1	0	0	0
	Run	87.0	13.7	1,192	49	11	0	0	0	18	0	0	0
11	HGR	93.0	14.3	1,330	34	26	0	0	0	15	1	0	3
	Pool	25.8	12.5	323	14	12	0	0	0	4	4	0	0
	Run	26.0	12.0	312	10	4	1	0	0	1	1	0	0
12	Run	81.0	20.4	1,652	51	21	5	1	0	14	0	0	0
	HGR	127.0	19.0	2,413	58	27	10	1	0	9	0	0	0
	Run	86.7	13.2	1,144	49	30	6	1	0	5	0	0	0
13	LGR	119.0	18.0	2,142	18	6	1	0	0	11	0	0	1
	Run	27.0	14.5	392	5	4	0	0	0	2	0	0	0
	Pool	24.1	14.2	342	19	6	1	0	0	3	0	0	0
14	Pool	27.5	11.6	319	6	3	0	0	0	22	1	0	0
	Run	12.0	12.0	144	5	3	0	0	0	0	0	0	0
	HGR	26.0	12.8	333	3	1	0	0	0	2	0	0	0
	Pool	11.0	12.0	132	4	3	1	0	0	0	1	0	1
	LGR	16.2	16.7	271	2	0	2	0	0	4	0	0	0
	Pool	29.3	16.2	475	0	0	0	0	0	1	1	0	0
15	Pool	44.0	11.4	502	37	10	0	0	0	3	35	0	0
	HGR	30.5	11.3	345	2	1	0	0	0	1	0	0	0
	Run	18.3	19.7	361	11	3	0	0	0	6	5	0	0
	Glide	37.0	22.3	825	0	3	0	0	0	2	1	0	0

Appendix C. Summary of density and biomass statistics for stream fisheries in Idaho.

Stream name and year	Section and (regulations)	Species	Mean length (mm)	Mean weight (a)	Mean density (#/ha)	Mean biomass (kg/ha)	Source
Middle Fork Boise Summer, 1988	Willow Creek to Atlanta (general)	Rainbow	195.5	71.0[a]	65	4.6[g]	Rohrer 1989
North Fork Boise Summer, 1989	Middle Fork to Graham (general)	Rainbow	188.8	63.7[a]	85	5.4[g]	Rohrer 1990
South Fork Payette Summer, 1992	Deadwood Reservoir to Grandjean (general)	Rainbow	211.8	85.4[f]	84	7.2[i]	Current Study
Blackfoot Summer, 1978-1980	Blackfoot Reservoir to Diamond Creek (general)	Cutthroat	248.0	189.9[b]	228	43.2[g]	Thurow et al. 1981
Silver Creek Summer, 1986	Cabin to Kilpatrick (special)	Rainbow Brown	- -	-[f] -[f]	279 2	92.5[g] 1.9[g]	Riehle et al. 1989
Silver Creek Summer, 1986	Martin Bridge to Priest (general)	Rainbow Brown	- -	-[f] -[f]	240 48	30.9[g] 18.9[g]	Riehle et al. 1989
Big Wood Summer, 1986	Glendale to Warm Springs (general)	Rainbow		-[f]	37	79.2[g]	Thurow 1987
South Fork Snake Fall, 1986	Conant Valley (general)	Cutthroat Brown	334.0 351.0	399.6[b] 476.6[b]	196 30	78.5[J] 14.5[i]	Elie et al. 1987
Henrys Fork Spring, 1987	Box Canyon (special)	Rainbow	250.0	195.0[f]	553	107.8[k]	Angradi and Contor 1989

Appendix C. (continued)

Stream name and year	Section and (requlations)	Species	Mean length (mm)	Mean weight (g)	Mean density (#/ha)	Mean biomass (kq/ha)	Source
Henrys Fork Summer, 1980	Fritz to Ora (general)	Rainbow	264.0	221.O[r]	612	135.2[i]	Rohrer 1981
Portneuf Spring, 1987	Steel to Broxon (general)	Rainbow	268.5	200.6[c]	472	94.7[g]	Mende 1989
		Cutthroat	291.4	284.0[b]	77	22.0[g]	
Big Lost Summer, 1987	Below Mackay Reservoir (general)	Rainbow	315.0	324.4[c]	770	249.8[l]	Corsi and Elie 1989
		Brook	225.0	108.4[d]	260	28.2[h]	
Lochsa Summer, 1990	Pete King to Boulder Creek (general)	Cutthroat	225.0	243.1[c]	4	0.9[k]	Hunt - personal communication
Lochsa Summer, 1990	Boulder Creek to Powell (special)	Cutthroat	266.4	413.2'	57	23.6[k]	Hunt - personal communication
North Fork Clearwater Summer, 1990	Isabella Creek to Cedars C.G. (general)	Cutthroat	251.9	346.6[e]	4	1.4[k]	Hunt - personal cormmunication
Kelly Creek Summer, 1990	Bernard Creek to Box Canyon (special)	Cutthroat	262.4	394.1[e]	105	41.4[k]	Hunt - personal communication
Coeur d'Alene Summer, 1991	Enaville to Yellowdog Creek (general)	Cutthroat	231.7	266.5[e]	26	6.9[k]	Hunt - personal communication
Coeur d'Alene Summer, 1991	Yellowdog Creek to Tepee Creek (special)	Cutthroat	259.0	378.1[e]	106	40.1[k]	Hunt - personal communication

Appendix C. (continued)

Stream name and year	Section and (regulations)	Species	Mean length (mm)	Mean weight (g)	Mean density (#/ha)	Mean biomass (kg/ha)	Source
St. Joe Summer, 1990	Calder to Prospector Creek (general)	Cutthroat	260.6	385.6`	35	13.5[k]	Hunt - personal communication
St. Joe Summer, 1990	Prospector Creek Ruby Creek (special)	Cutthroat	247.8	329.1`	358	117.8[k]	Hunt - personal communication
Spokane Summer, 1985-86	Post Falls Dam to Washinton border (general)	Rainbow				52.0[h]	Underwood and Bennett 1992

[a] Mean weight calculated using South Fork Boise River length-weight relationship after Moore, 1979.
[b] Mean weight calculated using South Fork Snake River length-weight relationship after Moore, 1980.
[c] Mean weight calculated using Big Wood length-weight relationship after Thurow, 1990.
[d] Mean weight calculated using Big Wood length-weight relationship after Thurow, 1987.
[e] Mean weight calculated using length-weight relationship after Rieman, 1989.

[f] Length-weight relationship developed by study authors.
[g] Biomass calculations represent fish >_ 100 mm.
[h] Biomass calculations represent fish a 130 mm.
[i] Biomass calculations represent fish ? 150 mm.
[j] Biomass calculations represent fish a 170 mm.
[k] Biomass calculations represent fish >_ 175 mm.
[l] Biomass calculations represent fish >_ 180 mm.

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Similarly, variation in river and stream flow probably influenced many of the trends identified in periphyton and macroinvertebrate metrics. Overall, while the absence of wide scale deteriorating trends in water quality and ecological health is positive, many of the RSoE sites are considered â€˜degradedâ€™, with some very degraded when considered in the national context.Â Rivers and streams in the Wellington region Permanently flowing rivers and streams Intermittently flowing rivers and streams Regionally significant rivers and streams Key anthropogenic pressures on river and stream health Landcover and land use Significant consented activities.Â 4. Provide information to assist in targeted investigations where remediation or mitigation of poor water quality is desired; and. Easy Science for Kids Rivers and Streams - How They Are Formed - learn fun facts about animals, the human body, our planet and much more. Fun free Rivers and Streams - How They Are Formed activities!Â Rivers and Streams â€“ How They Are Formed. Mountains and hills tend to slow rain clouds down, squeezing the water from them. These high points usually get more rainfall than the surrounding areas. When rain falls, it has to go somewhere. Gravity causes it to run down the hills. As it runs down the hills and onto the surrounding area, it gathers in an area called a watershed, which is a valley with lots of little streams. The little streams run together to make rivers. Small rivers join to make larger rivers. Finally, a river runs all the way to the ocean or into lakes.