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South Fork Boise River
Creel Census and Fish Population Studies

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Period Covered: 1 January to 31 December 1978

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April, 1979

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ABSTRACT

During the census period, 1 December1977 to 33 November 1978, anglers fished an estimated 22,357 hours and caught an estimated 44,279 fish from the South Fork Boise River between Anderson Ranch Dam and Danskin Bridge (18.9 km). Rainbow trout, caught and released, accounted for 66.8% of the total catch. During the 6-month general season, 27 May to 30 November 1978, caught and released rainbow trout accounted for 76.3% of the catch. Harvested mountain whitefish accounted for 62.7% of the catch during the winter season, 1 December 1977 to 31 March 1978.

The rainbow trout harvest during the general season was estimated at 1,677 fish. These fish averaging 372 mm (14.6 **in)** total length, the same mean length recorded during the 1977 general season. The proportion of rainbow trout over 406 mm (16 in) in the harvest has increased from 5% and 18% for 1976 and 1977, respectively, to 26% for 1978. The general season catch rate was 1.64 rainbow trout per hour. The catch rate for whitefish was very constant in all three census sections resulting in 0.39 whitefish per hour. A catch of 7,276 whitefish accounted for 19.2% of the total general season estimated catch.

The 4-month winter whitefish season, 1 December 1977 to 31 March 1978, accounted for 4,011 harvested whitefish. The mean size of the harvested whitefish has remained constant during the three winters that census data has been recorded. In 1973-74, the mean size was 345 mm (13.6 in) total length. This length was identical in 1976-77 and again during the most recent census, 1977-78. Whitefish catch rates averaged 1.54 fish per hour, This figure dropped from 2.5 fish per hour for the previous season (1976-77). The drought of 1976-77 caused low flows (200 cfs) all winter and access to the South Fork was good due to dry roads. Anglers caught and released an estimated 675 rainbow trout, 10.5% of the total winter season catch for 1978.

As in the past, most South Fork anglers were nearby residents. More than 75% of the interviewed anglers were from Boise or Mountain Home. Non-residents comprised 6.3% of the general season anglers, while less than 1% were non-residents during the winter whitefish season.

Anglers using fly rods and artificial flies comprised over 80% of rod and lure types used during the general trout season (27 May to 30 November 1978). In previous years, winter whitefish season anglers heavily favored spinning rods and bait. During the 1977-78 winter season, however, anglers showed increased preference for fly rods and flies. Angler preference between these two rod and lure types neared the 50 percentile mark.

Spawning criteria for water depth and water velocity of river spawners were very similar to 1977 values, being 27.1 cm (10.6 in) and 0.55 m^3/s (1.8 fps), respectively. Mean length of female spawners was 378 mm (14.9 in), the same as in 1977. The mean length of mature males was 317 mm (12.5 in), a decrease from the 1977 value of 346 mm (13.6 **in).**

Tributaries were found to be more important in 1978 than in 1977 with more spawning activity taking place in them. Surveys showed Mennecke Creek to have the most spawner use and more potential spawning habitat than all other South Fork tributaries combined.

Back calculation of length for wild rainbow trout based on regression analysis of scale samples showed lengths at annulus one through five as, 105 mm, 193 mm, 286 mm, 357 mm and 414 mm. Rainbow became large enough for harvest sometime during their fourth year of life (3T).

Whitefish of up to 10-years old were found with the majority being 5 years. Mean growth increments show growth was rapid to age 3 and remained nearly constant from ages 4 through 10.

Mean condition factors were 0.99 for wild rainbow and 0.92 for mountain whitefish sampled during the summer.

Tagged rainbow trout showed little movement: 54% displayed no movement, 27% moved upstream and 19% moved downstream. Movement which did occur was mainly associated with spawning activities. Whitefish movement was even less than rainbow with 71% moving less than 1.0 km.

Population trends indicate an increase in the number of age 2+ fish in the population over previous years. These fish should be large enough for harvest sometime in 1979.

Mortality estimates indicate the special regulations initiated in 1976 have decreased annual mortality from 82% in 1974 to 67% **in** 1978. Natural mortality has increased since 1976 by 6% and may be related to hooking mortality caused by the catch-and-release fishery.

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OBJECTIVES

The purpose of this study is to gather fishery resource data on the South Fork of the Boise River between Anderson Ranch Dam and Arrowrock Reservoir. Data collected is intended to be used by the Bureau in the Anderson Ranch Powerplant Third Unit Study.

The work to be performed involves:

(1) Gathering fishery resource data base for future planning studies;

(2) Monitoring angler use, catch and catch composition;

(3) Monitoring changes in abundance of gamefish populations;

(4) Monitoring changes in age structure and length frequency composition of gamefish populations.

INTRODUCTION

The lower South Fork Boise River, historically an anadromous fish stream, was bracketed by Arrowrock Reservoir in the west and Anderson Ranch Dam in the east by 1943. Operation of Anderson Ranch Dam produces widely fluctuating winter peaking flows and high but constant summer irrigation release flows. Water temperatures in the river are relatively constant year round because the outlet works of Anderson Ranch Dam draws water from low in the reservoir pool.

By 1975, when the first detailed fishery study conducted by the Idaho Department of Fish and Game (Beach 1975) was completed, the South Fork had long been recognized as an excellent fishery for resident rainbow trout and mountain whitefish. Two angling seasons were available, one a 6-month trout season and the other a 4-month winter whitefish season.

The trout season was covered by statewide general trout regulations allowing harvest of both trout and whitefish. Beach (1975) estimated that 26,443 angling hours produced 22,056 fish caught during the 1974 trout season. The catch consisted primarily of harvested hatchery rainbow trout (11,832) and harvested wild rainbow trout (5,710). The hatchery rainbow fishery was supported by stocking of about 15,000 catchable-size rainbow each year (Beach 1975).

The winter whitefish season of 1973-74 produced an estimated harvest of 3,063 whitefish in 2,471 angling hours. Regulations restricted the harvest to whitefish only.

In 1976, the South Fork was designated as a special trout regulation area and hatchery releases were terminated. Special trout regulations were initiated in order to provide a quality wild rainbow trout fishery based on limited harvest and natural reproduction. The special trout regulations consisted of a three-trout bag and possession limit with a 305 mm (12 in) minimum length for trout reduced to possession. Fishing gear was restricted to artificial flies and lures only and angling from motorized boats was prohibited.

In 1977 regulations were further restricted to artificial flies and lures with

single barbless hooks.

Studies conducted during 1976 and 1977 (Mate 1977, 1978) demonstrated the success of special regulations with the fishery showing an increase in both catch rate and mean total length for wild rainbow. This was due primarily to lower mortality caused from a reduction in angler effort and an increase in the number of fish caught and released (90% of the total catch for 1977) since 1974. This past work indicates the South Fork fishery is still developing.

Plans by the Bureau of Reclamation for changes in the operation of Anderson Ranch Dam include the addition of a third generator which would increase flows for peaking and the possible addition of a reregulation dam. Changes in water release management could produce deleterrious changes in the South Fork fishery. This, plus the fact the South Fork is developing into an excellent trophy trout fishery, accentuates the need for continued monitoring.

This study is the cumulation of the collection of baseline data for evaluating the fishery resource and the effects of water management changes on that fishery.

DESCRIPTION OF STUDY AREA

The South Fork Boise River and its tributaries from Anderson Ranch Dam to Neal Bridge, a distance of 45.4 km (28.2 mi), encompasses the study area. It is physically divided into two areas by a canyon which begins near Trail Creek and runs downstream 19.2 km (11.9 mi) to Neal Bridge (Fig. 1). This canyon is narrow with access severely restricted due to a nearly vertical 300-m (984-ft) drop from the canyon rim to the river and a lack of roads. The river here is narrow, swift and lacks pools, with predominantly rubble and boulder substrate (larger than 30.5-cm diameter) (Wade et al. 1978). This area is becoming popular as a whitewater float area of short duration and wilderness quality.

The river from Trail Creek upstream to Anderson Ranch is generally broad, shallow, and characterized by riffles and runs with cobble (7.6 - 15 cm) and rubble (15.2 - 30.5 cm) being the dominant substrate types" (Wade et al. 1978). Frequent rock outcrops in narrow sections create deep pools and rapids. The adjacent bottom lands are 30 to 200 m (98 - 656 ft) wider than the stream channel which has several areas of braiding. The valley in this area is bounded by slopes of 40 to 80% (Bureau of Reclamation 1977).

River flows vary from 5.5 m^3/s (195 cfs) to over 71 m^3/s (2,500 cfs). Flows are normally regulated by Anderson Ranch Dam for irrigation and power. Maximum flows occur in May during normal wat$_e$r years when the reservoir fills and spill occurs. Flow is then held at 42.5 m '/s (1,500 cfs) during the summer irrigation season until about 1 September when it is reduced to 5.5 m^3/s (195 cfs). During the winter, when peaking operations for power are in effect at the dam, flows fluctuate daily from 5.5 to 45.30/s (195 - 1,600 cfs).

TECHNIQUES USED

Creel Census

Creel census counts and interviews were conducted during the 4-month winter whitefish season (1 December 1977 - 31 March 1978) and the 6-month general trout

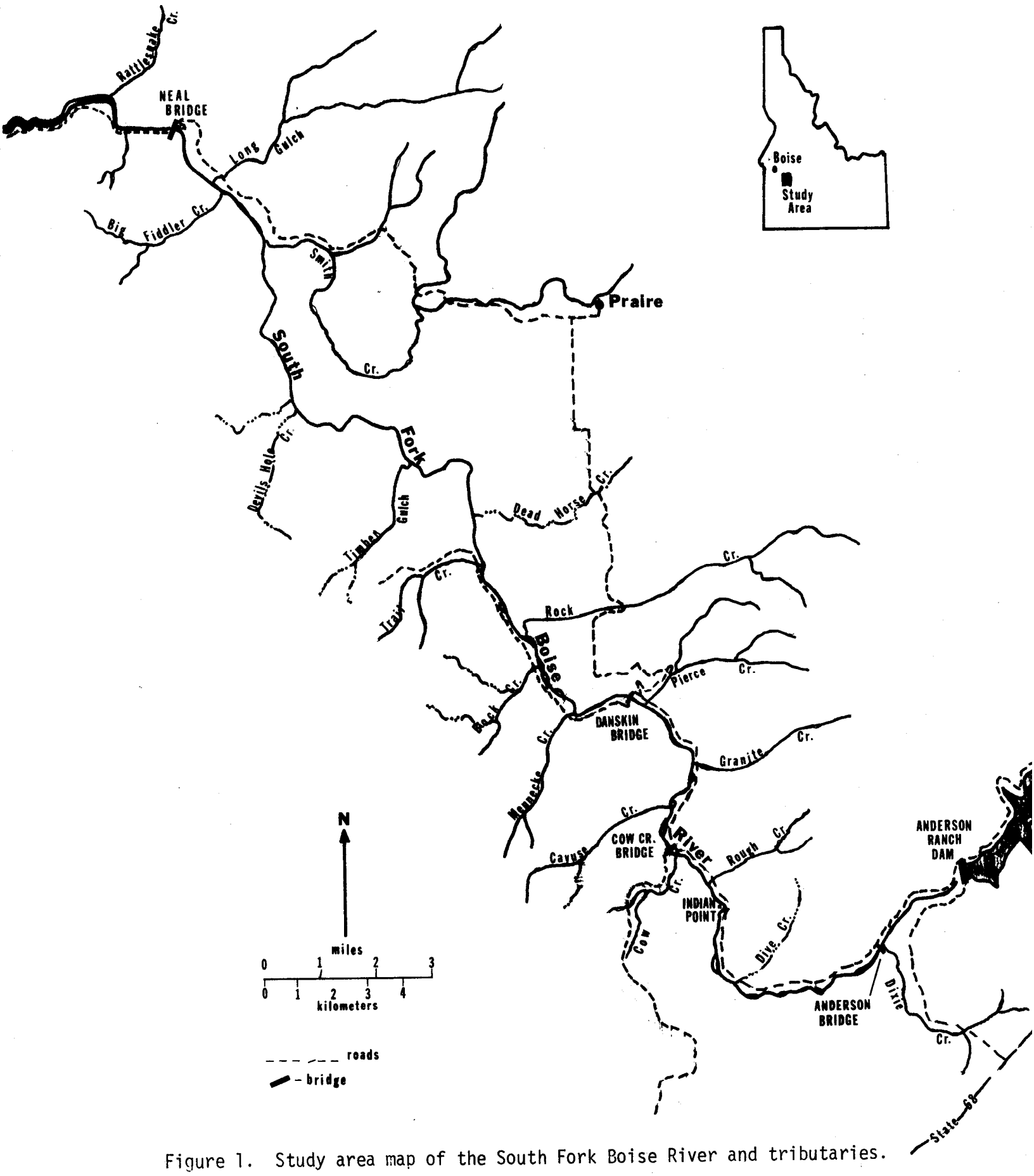


Figure 1. Study area map of the South Fork Boise River and tributaries.

season (27 May - 30 November 1978). Census counts were made by car in the roaded river section from Anderson Ranch Dam to Danskin Bridge. Beach (1975) estimated that 6% of the general trout season angling occurred outside the public roaded portion of the South Fork from Danskin Bridge to Neal Bridge. No estimates were made of angling in this section from 1976 to 1978 as access had not improved and fishing effort was considered similar.

The creel census procedure consisted of angler counts conducted on 50% of the weekend days and 20% of the weekdays in each 28-day census interval (Mate 1977). Specific count days and times were chosen randomly. The total daylight period for each count day was divided into four equal time periods with an angler count made in each period. The earliest count time was randomly selected within the first count period and counts **in** subsequent periods were evenly spaced in time. A maximum of 1 hour was allowed to complete each angler count and counts were considered instantaneous in making estimates.

We used angler counts to calculate average angler counts for weekdays and weekend days in each census interval as follows:

$$\frac{\text{Total anglers counted}}{\text{Number of counts}} = \text{Average anglers per count}$$

Multiplication of average anglers per count times days in interval, times daylight hours, yielded an estimate of total angler use. By combining angling hours for weekdays and weekend days we estimated total angling effort in each 28-day census interval.

We interviewed as many anglers as possible to document average catch rates, catch composition and fish length frequencies. Catch estimates were made by combining average catch rates derived from angler interviews with total use estimates. Residence, fishing license class, type of angling gear and method of angling were also recorded for all anglers interviewed.

Initially, the roaded portion of the South Fork was divided into two sections (Anderson Ranch Dam to Indian Rock and Indian Rock to Danskin Bridge) - we separately estimated effort and catch for these sections to allow comparison with previous creel census estimates for the South Fork (Beach 1975, Mate 1977). For the 1977 and 1978 general trout seasons, the roaded portion was divided into three sections: section 1, from Anderson Ranch Dam to Anderson Bridge, covers the 3.3 km (2.1 mi) area effected by the proposed re-regulation dam; section 2, from Anderson Bridge to Indian Rock (7.9 km, 4.9 mi) and section 3, from Indian Rock to Danskin Bridge (7.6 km, 4.7 mi).

Test Angling

Because of the length restriction on harvested trout, angler interviews did not provide a complete length frequency of all rainbow trout caught. Test angling was conducted to establish rainbow length data comparable to the length data collected by Beach (1975) and to develop a better picture of the rainbow trout population. Most of this data was gathered by project personnel during tagging operations, but several sportsmen who frequent the area were asked to keep records on all fish caught and released. This information was added to project data in the final analysis and is considered to be representative of the catch and release fishery.

Rainbow Trout Spawning

Rainbow trout spawning area surveys and spawning criteria measurements were continued in 1978 as previously described (Wade et al. 1978). This information was combined with the 1977 data for presentation here.

Age and Growth

Wild rainbow trout and mountain whitefish were aged using scale analysis. We captured fish by angling, gill netting and shocking and removed several scales posterior to the dorsal fin and just above the lateral line and placed them in envelopes. Scales were dry mounted between microscope slides and read with a microprojector at 67.5 x for rainbow and 26.4 x for whitefish. Ages were determined using number of annuli on the anterior circuli field. Annuli were determined as described by Lagler (1956) and Royce (1972). Distance from each annulus to the focus was determined by measuring along the longitudinal anterior scale axis. All scales were read by two persons.

Using paired data on total length and anterior scale radius (ASR) a regression line for the body scale relationship was determined. A Hewlett Packard-1200 E calculator and plotter were used to examine five regression models; an exponential, $y=ae^{bx}$; a power relationship, $y=ax^{b}$; a logrithmic, $y=a+binX$; a linear, $y=a+bx$; and a parabolic, $y=a+bx+cx^{2}$. Using r^{2} values, the line which best fit the data plot was determined. Lengths were then back calculated using mean ASR values for each age class, and used to determine increment of growth for each year of life.

Fish Movement

Rainbow trout and mountain whitefish were tagged in the South Fork study area to assess movement. Both species were captured by angling and tributary electro-fishing. Total length, river location, tag number and date were recorded for each fish. A total of 679 rainbow over 160 mm (6,3 in) in length were tagged with monel jaw tags (size 8) throughout the study area from 21 April 1976 to 11 November 1978. Orange floy tags were used to tag 367 whitefish during April 1977 at three locations: Reclamation Village, Indian Point, and Danskin Bridge.

Tag return data were gathered from anglers during creel census interviews and by voluntary postal returns. Observations were also made on the location of smaller trout and whitefish while snorkeling the river. Some of the whitefish tags were recovered during river electrofishing.

Population Estimates

Electrofishing

Many attempts at electrofishing have been undertaken in the South Fork and most have been unsuccessful. Beach (1975) and Wade et al. (1977) found the low conductivity (less than 100 mhos) would not allow electrical fields to form in the water which would elicit electrotaxis or electronarcosis in the fish with their equipment. In October of 1978 a Coffelt VVP Electrofisher was obtained and utilized on the South Fork. This unit, when coupled with a large diameter positive electrode and high voltages (450 VDC), produced adequate electrical current to stimulate fish response. We found this unit especially effective on whitefish.

Even though shocking of South Fork fish was effective, our goal of population estimates was not realized due to the swiftness of flow. Even at 5.5 m3/s (195 cfs), most shocked fish were swept away before they could be netted and wading conditions were hazardous. The clarity of the water allowed the rainbow to see us, which let the majority escape before the shocker was close enough to create a response. These conditions were not conducive to accurate mark-recapture estimates or successive removal estimates.

Snorkel Transects

Snorkel transects were established in 1978 in each census section for rainbow trout enumeration during the fall low flows (5.5 m^3/s). Two men snorkeled opposite banks and counted all rainbow trout and Dolly Varden which were within their field of vision. Whitefish were not counted although general observations were recorded. Transects were selected which did not have large deep pools because of the difficulty in seeing and counting the fish in deep water with their random movements about the snorkelers.

Transect 1 was from 1.3 road km (0.8 mi) above Anderson Bridge to the bridge, starting at the head of a riffle below a large pool. Transect 2 was from the boat ramp by Reclamation Village to the second old bridge abutments 1.9 km (1.2 mi) downstream. Transect 3 was from 1.6 road km (1.0 mi) above the Cow Creek Bridge to the bridge.

Mortality Estimates

Total mortality (Z) was estimated using catch curves based on age classes as described by Royce (1972) and Lackey (1974). The slope of the line between any two ages is equal to Z for that year and the greater the slope the higher the mortality. Catch curves were constructed for both fish sampled from the creel and fish sampled by test angling. The former was used as the best estimator of Z.

Natural mortality (M) was estimated by extrapolating the plot of fishing effort and Z by linear regression to fishing effort equal to zero. Other mortality estimates were determined as follows:

total survivability rate = $S = e^{-Z}$ (antinatural log of -Z)

total mortality rate = 1-S

fishing mortality rate = $E = \frac{(1-S)F}{Z}$

natural mortality rate = $D = \frac{(1-S)M}{Z}$

using Z and M previously calculated.

Effort used in calculating M for rainbow was effort expended for fish creeled and did not include that effort utilized in the catch and release fishery.

Terminology

The use of the terms catch, catch and release harvest, and creeled may be confusing to the reader. Catch and release fishing refers to those fish returned

alive to the water. Harvest and creeled are used to mean those fish reduced to possession by anglers. Catch, generally refers to all fish landed by anglers whether they are reduced to possession or released.

FINDINGS

Angler Use and Catch

Anglers fished an estimated 22,357 hours and caught an estimated 44,279 fish during 12 creel census intervals from 1 December 1977 to 30 November 1978. The 6-month general trout season accounted for 18,647 angling hours and produced 37,925 fish. Most of the fish were caught-and-released rainbow trout which comprised 76.3% of the general season catch. The 4-month winter season accounted for 3,710 angling hours and a total catch of 6,402 fish. Whitefish comprised 62% of the total winter catch or 4,011 fish.

During the winter season, the interval beginning 23 February 1978 has the highest effort and catch (Table 1). Catch rates for whitefish remained fairly constant throughout the winter season, with the only exception being during the interval beginning 23 March. Extreme fluctuations. in stream flows probably accounted for this drop in success. These fluctuations were part of a study being conducted by the University of Idaho on insect and fish displacement during peaking flows.

Angling effort and catch were low at the start of the general trout season (Table 2). Anderson Ranch Reservoir was filled by mid-May and heavy spilling occurred during the first month of the 6-month season. Effort and catch increased when spilling was terminated and flows were set at approximately 42.5 m^3/s (1,500 cfs) throughout the summer. Catch rates surpassed two rainbow trout per hour for certain periods of the summer. Effort and catch peaked in early fall and then dropped significantly when snow and wet roads confronted anglers daily at the end of October and during November.

Comparison of effort and catch for 3 years (1974-1977 and 1978) reveals that effort and catch in the winter whitefish season reached a peak during the period 1 Dec. 1976 to 31 March 1977 (Table 3). This is the year a severe drought caused low flows and dry roads all winter. Access to the South Fork was unlimited. The catch rate for the winter season was 2.67 fish per hour. The effort and catch dropped slightly during the period 1 December 1977 to 31 March 1978.

General trout season effort was highest and catch was lowest during pre-special regulation periods (Table 4). Effort and harvest of rainbow trout decreased initially while the number of rainbows caught and released has increased greatly. Catch rates for whitefish were high during the general trout season (29 May to 30 November) during 1976. Catch rates for whitefish dropped during the 1977 season while at the same time, the catch rate for caught and released rainbow trout increased (Mate 1978). Overall catch rates during 1976 and 1977 remained fairly constant. Regulations continued to depress effort (to a lessening degree) during the 1978 general trout season. Harvest of wild rainbow trout remained low and harvest of hatchery stock was non-extistent. The number of rainbow trout caught and released during 1978 was 16.7 times larger than in 1974 (pre-special regulation).

Overall catch rates have steadily increased over those of 1974 (the last year of general regulations). This is primarily due to decreased effort and increase

Table 1. Total estimated angling hours and catch in the South Fork Boise River from Anderson Ranch Dam to Danskin Bridge,by interval,during the winter whitefish season(l December 1977 to 31 March 1978).

Census interval starting date	Estimated angling hours	Whitefish harvested	Whitefish caught and released	Rainbow caught and released	Total catch
1 December 1977	334	421	221	84	726
29 December 1977	823	885	351	227	1,463
26 January 1978	631	513	498	128	1,139
23 February 1978	1,601	1,969	609	153	2,731
23 March 1978	321	223	37	83	343
Totals	3,710	4,011	1,716	675	6,402
Fish per hour		1.08	0.46	0.18	1.73
Percent of catch		63	27	10	

Table 2. Estimated angling effort and catch on the South Fork Boise River from Anderson Ranch Dam to Danskin Bridge for seven creel census intervals during the general trout season, 27 May to 30 November 1978.

Census interval starting date	Est. angling hours	Rainbow caught and released	rainbow harvested	Whitefish caught released	Whitefish harvested	Dolly Var. caught and released	Dolly Var. harvested	Total catch
27 May	1,636	849	155	95	9	0	9	1,117
24 June	2,292	4,323	170	59	0	0	0	4,553
22 July	3,903	5,263	413	546	16	0	0	6,238
19 August	4,150	7,961	298	925	127	48	8	9,367
16 September	4,656	7,726	419	3,590	326	0	0	12,061
14 October	1,756	2,414	186	1,102	289	0	5	3,996
11 November	254	366	35	120	72	0	0	593
Totals	18,647	28,902	1,677	6,437	839	48	22	37,925
Fish per hour		1.55	.09	.35	.04	<.01	<.01	2.03
Percent of total catch		76.2	4.4	17.0	2.2	<1	<1	100

Table 3. Estimated angling effort and catch for 1974, 1977 and 1978 on the South Fork Boise River from Anderson Ranch Dam to Danskin Bridge during the winter whitefish season, 1 December to 31 March.

Year	Estimated angler hours	Whitefish harvested	Whitefish caught and released	Rainbow caught and released	Total catch	Catch rate (fish/hr.)
1974	2,471	3,063	-	139	3,202	1.30
1977	4,249	10,565	77	713	11,355	2.67
1978	3,710	4,011	1,716	675	6,402	1.73

Table 4. Estimated angler hours and catch during the general trout season for 4 years, (1974, 1976, 1977, 1978) on the South Fork Boise River from Anderson Ranch Dam to Danskin Bridge.

Period covered	Angler hours	Wrb. harvested	Hrb. harvested	Rb caught & released	Whitefish harvested	Whitefish caught & released	Dolly Varden harvested	Total catch	Catch rate
25 May - 30 Nov. 1974	26,443	5,710	11,832	1,730	1,727	-	51	21,050	.80
29 May - 30 Nov. 1976	14,958	1,325	226	9,525	1,286	4,928	58	17,348	1.16
28 May - 30 Nov. 1977	12,117	1,103	0	10,715	481	1,541	8	13,848	1.14
27 May - 30 Nov. 1978	18,647	1,677	0	28,902	839	6,437	22	37,877	2.03

of caught and released wild rainbow trout; Catch. rates for the entire year of 1978 reached 1.98 fish per hour for 411 species. The two species caught most were whitefish during the winter season with a catch rate of 1.54 fish per hour (Table 5) and wild rainbow trout during the general trout season with a catch rate of 1.64 fish per hour (Table 6). Data compiled by Beach (1975) showed the overall catch rate was 0.84 fish per hour for the period 1 December 1973 to 30 November 1974. Mate (1977, 1978) showed the overall catch rate was 1.16 and 1.54 fish per hour for 1976 and 1977, respectively.

During the winter whitefish season, 1 December 1977 to 31 March 1978, section II (Anderson Bridge to Indian Rock) provided the highest catch rate for whitefish (Table 5). Catch rates never fell below one fish per hour in any of the three creel census sections for the entire period.. Section I (Anderson Ranch Dam to Anderson Bridge) produced the highest catch rate for caught and released rainbow trout.

The general trout season, 27 May to 30 November 1978, exhibited catch rates far in excess of 1977 values (Mate 1978). As in 1977, catch rates were fairly constant over the entire 18.9 km (11.7 mi) portion of the river under study. Mate (1978) reported a catch rate of 0,97 rainbow trout per hour for the 1977 general season. The catch rate increased to 1.64 rainbow trout per hour for the same period in 1978 (Table 6). The census section from Indian Rock to Danskin Bridge (III) had the highest catch rate of 1.76 rainbow trout per hour. Whitefish catch rates were constant throughout the study area with 0.39 whitefish per hour. Overall catch rate for both species in the general season was 2,03 fish per hour. When stream mileage of each census section is considered, Section I (Anderson Ranch Dam to Danskin Bridge) had the highest catch density for both rainbow trout and mountain whitefish in the general season (Table 6). Catch density also remains the highest for rainbow trout in Section I during the 1977-78 winter whitefish season (Table 5).

When fishery investigations first began (1 December 1973) at the South Fork Boise River between Anderson Ranch Dam and Danskin Bridge, approximately 15,000 hatchery-reared rainbow trout were introduced into the system every year. Beach (1975) reported that 58% of the total 1974 rainbow trout plant was harvested that same year. Hatchery stock was again introduced during the summer months of 1975, this being the last time hatchery-reared rainbow were released into the South Fork below Anderson Ranch Dam. No creel census was undertaken in 1975 to determine effort and catch. When the creel census was resumed in May 1976, 226 hatchery rainbow trout were harvested, comprising 1.3% of the total catch (Mate 1977). Apparently, very few hatchery-reared trout introduced in 1975 survived the winter with only occasional catches of hatchery fish found in 1976. Most of these fish were approximately 305 mm (12 in) total length and were caught in the spring. They could be fish from Anderson Ranch Dam released during periods of heavy spilling. During electrofishing surveys in the fall of 1978, one large hatchery-reared trout was captured. This fish, measuring 550 mm (21.7 in) was tagged and released.

Catch rates have increased steadily, even with the cessation of hatchery-reared trout introductions. Effort decreased substantially when special restrictive regulations were imposed at the start of the 1976 general trout season. While harvest of rainbow trout decreased as a result of the regulations, the number and size of rainbow trout caught and released increased markedly.

Composition of angler catch in the three creel census sections changed

Table 5. Catch rates and densities in three creel census sections on the South Fork Boise River during the winter whitefish season, 1 December 1977 to 31 March 1978.

Section	Fish/hour			Fish/mile		
	Rainbow trout	Mountain whitefish	Both	Rainbow trout	Mountain whitefish	Both
Anderson Ranch Dam to Anderson Bridge 3.4 km (21 mi)	.33	1.03	1.36	103.3	320	423.3
Anderson Bridge to Indian Rock 7.9 km (4.9 mi)	.17	1.82	1.99	78.6	824.9	903.5
Indian Rock to Danskin Bridge 7.6 km (4.7 mi)	.09	1.20	1.28	15.5	215.5	231.0
Anderson Ranch Dam to Danskin Bridge 18.9 km (11.7 mi)	.18	1.54	1.72	57.7	489.4	547.1

Table 6. Catch rates and densities in three creel census sections in the South Fork Boise River during the general trout season 27 May to 30 November 1978.

Census section	Fish/hour			Fish/mile		
	Rainbow trout	Mountain whitefish	Both	Rainbow trout	Mountain whitefish	Both
(I) Anderson Ranch Dam to Anderson Bridge 3.4 km (2.1 mi)	1.57	.38	1.95	3,033	733	3,777
(II) Anderson Bridge to Indian Rock 7.9 km (4.9 mi)	1.58	.39	1.97	2,609	641	3,250
(III) Indian Rock to Danskin Bridge 7.6 km (4.7 mi)	1.76	.40	2.15	2,431	551	2,982
Anderson Ranch Dam to Danskin Bridge 18.9 km (11.7 mi)	1.64	.39	2.03	2,614	622	3,235

dramatically during the 1977-1978 winter whitefish season. In the sections from Anderson Bridge to Indian Rock (II) and Indian Rock to Danskin Bridge (III) over 91% of the total catch consisted of whitefish. In the section from Anderson Ranch Dam to Anderson Bridge (I) more trout were caught and the percentage catch of whitefish dropped to 75.6% (Table 7). Catch composition varied only slightly from interval to interval except in Section III. The variation in composition could be attributed to the low number of anglers interviewed in that section during the intervals beginning 1 December 1977 and 23 March 1978. Catch composition during the general trout season reverses from the winter season. During the 1978 general trout season, the catch consisted of more than 80% rainbow trout throughout all three creel census sections (Table 8). Beach (1975) and Mate (1977) recorded similar findings during their investigations on the South Fork. Changes in composition during the general season correspond with the drastic cut in flows at the end of the irrigation season (approximately 1 September). The change in composition did not mean that fewer trout were caught. During this period (interval beginning 19 August 1978), more trout were caught than during any other interval (Table 1). The next interval (16 September to 13 October 1978) had the second highest number of trout caught. Many more whitefish were caught during these two intervals, also. Beach (1975) and Mate (1978) reported peaks in wild rainbow catch in 1974, 1976 and 1977 coincided with reductions in South Fork water flows when irrigation releases were terminated.

Section II (Anderson Bridge to Indian Rock) provided the highest success during the winter season accounting for 69% of the total catch (Table 9). Most anglers (60%) preferred fishing in Section II during the winter season. During the general trout season 27 May to 30 November 1978, effort and catch tend to be quite uniform when stream mileage is considered (Table 10). Angler preference for fishing spots changed very little from the 1977 general trout season (Mate 1978).

Angling methods and gear type have changed slightly during the general trout season in the past 3 years. There is a trend toward wading and fishing with a fly rod and artificial fly. Boat use was reported by 3% of the anglers at the South Fork in 1976 (Mate 1977). This increased to 5% in 1977 (Mate 1978) and 6.3% in 1978. We believe that this 6.3% estimate is low. Boat anglers are difficult to interview on the river. After they have launched it is difficult to determine their whereabouts on the river and the actual number of fishermen in the boat. Project personnel must try and predict the landing spot and time of arrival for purposes of complete and accurate interviews. With census interviews scheduled for the entire 18.9 km (11.7 mi) portion of the river under study, a rendezous between boat anglers and project personnel was sometimes not possible. For this reason, actual boat use could be higher than 6.3%. Preference for fly rods has increased from 64% and 79% in 1976 and 1977, respectively (Mate 1977, 1978), to 80.6% in 1978. Preference for artificial flies was reported at 69% and 85% in 1976 and 1977. This increased slightly to 87% in 1978.

The largest change in angling methods and gear types was demonstrated by anglers during the winter whitefish season. Mate (1977) reported that 74% of the anglers preferred using a spinning rod and 71% preferred using bait during the winter season, 1 December 1976 to 31 March 1977. During the winter season (1 December 1977 to 31 March 1978), preference changed significantly and nearly half of the anglers preferred using a fly rod and artificial flies (Table 11).

Table 7. Percentage composition of angler catch in three creel census sections by census interval for the winter whitefish season, 1 December 1977 to 31 March 1978,to South Fork Boise River.

Census interval starting date	Percent of catch	
Anderson Dam to Anderson Bridge (3.4 km)		
	Rainbow trout	Mountain whitefish
1 December 1977	8.7	91.3
29 December 1977	53.3	46.7
26 January 1978	19.9	80.0
23 February 1978	21.0	79.0
23 March 1978	17.3	82.7
Entire period	24.4	75.6
Anderson Bridge to Indian Rock (7.9 km)		
	Rainbow trout	Mountain whitefish
1 December 1977	14.6	85.4
29 December 1977	10.5	89.5
26 January 1978	11.8	88.2
23 February 1978	3.0	97.0
23 March 1978	22.0	78.0
Entire period	8.7	91.3
Indian Rock to Danskin Bridge (7.6 km)		
	Rainbow trout	Mountain whitefish
1 December 1977	0.	100.0
29 December 1977	17.5	82.5
26 January 1978	3.4	96.6
23 February 1978	3.8	96.2
23 March 1978	100.0	0

Table 8. Percentage composition of angler catch in three creel census sections by census interval for the general trout season, 27 May to 30 November 1978, South Fork Boise River.

Census interval starting date	Percent of catch	
	Rainbow trout	Mountain whitefish
Anderson Dam to Anderson Bridge (3.4 km)		
27 May	82.4	16.2
24 June	89.8	10.2
22 July	85.6	14.4
19 August	80.5	19.0
16 September	79.8	20.2
14 October	74.4	25.5
11 November	78.8	21.2
Entire period	80.4	19.4
Anderson Brid9e to Indian Rock (7.9 km)		
27 May	89.7	9.5
24 June	99.5	.5
22 July	92.0	8.0
19 August	91.5	7.8
16 September	57.6	42.4
14 October	60.0	39.8
11 November	64.0	36.0
Entire period	80.1	19.7
Indian Rock to Danskin Bridge (7.6 km)		
27 May	91.9	7.5
24 June	99.5	.5
22 July	90.8	9.2
19 August	89.8	9.6
16 September	67.1	32.9
14 October	65.1	34.8
11 November	68.0	32.0
Entire period	81.4	18.5

Table 9. Estimated angling effort and catch in three creel census sections by census interval for the winter whitefish season, 1 December 1977 to 31 March 1978, South Fork Boise River.

Census interval starting date	Angler hours	Whitefish caught and released	Whitefish harvested	Rainbow caught and released	Total catch
Anderson Ranch Dam to Anderson Bridge (3.4 km)					
1 December 1977	52	74	0	7	81
29 December 1977	56	70	0	80	150
26 January 1978	113	105	0	26	131
23 February 1978	334	120	174	77	371
23 March 1978	99	0	129	27	156
Total	654	369	303	217	889
Anderson Bridge to Indian Rock (7.9 km)					
1 December 1977	200	77	374	77	528
29 December 1977	572	252	801	123	1,176
26 January 1978	364	393	314	95	802
23 February 1978	890	365	1,335	53	1,753
23 March 1978	184	37	94	37	168
Total	2,210	1,124	2,918	385	4,427
Indian Rock to Danskin Bridge (7.6 km)					
1 December 1977	82	70	47	0	117
19 December 1977	195	29	84	24	137
26 January 1978	154	0	199	7	206
23 February 1978	377	124	460	23	607
23 March 1978	38	0	0	19	19
Total	846	223	790	73	1,086

Table 10. Estimated angling effort and catch in three creel census sections by census interval for the general trout season, 27 May to 30 November 1978, South Fork Boise River.

Census interval starting date	Angler hours	Rainbow caught and released	Rainbow. harvested	Whitefish caught and released	Whitefish harvested	Dolly Varden caught & released	Dolly Varden harvested	Total catch
Anderson Ranch Dam to Anderson Bridge (3.4 km)								
27 May	376	86	36	22	2	0	2	148
24 June	398	322	30	40	0	0	0	392
22 July	521	386	54	72	2	0	0	514
19 Aug.	919	1,884	66	432	28	11	2	2,423
16 Sept	1,433	2,694	129	616	100	0	0	3,539
14 Oct.	372	536	39	190	7	0	1	773
11 Nov.	38	103	5	18	11	0	0	137
Total	4,057	6,011	359	1,390	150	11	5	7,926
Anderson Bridge to Indian Rock (7.9 km)								
27 May	574	287	54	33	3	0	3	380
24 June	869	1,920	65	9	0	0	0	1,994
22 July	1,862	2,886	198	261	8	0	0	3,353
19 Aug.	2,028	3,671	146	264	62	23	4	4,170
16 Sept.	1,723	2,257	155	1,654	121	0	0	4,187
14 Oct.	821	780	87	304	271	0	2	1,444
11 Nov.	206	247	29	97	58	0	0	431
Total	8,083	12,048	734	2,622	523	23	9	15,959

(Cont.)

Table 10. (Continued)

Census interval starting date	Angler hours	Rainbow caught and released	Rainbow harvested	Whitefish caught and released	Whitefish harvested	Dolly Varden caught & released	Dolly Varden harvested	Total catch
Indian Rock to Danskin Bridge (7.6 km)								
27 May	686	476	65	40	4	0	4	589
24 June	1,025	2,081	76	10	0	0	0	2,167
22 July	1,520	1,991	161	213	6	0	0	2,371
19 Aug.	1,203	2,406	86	229	37	14	2	2,774
16 Sept.	1,500	2,775	135	1,320	105	0	0	4,335
14 Oct.	563	1,098	60	608	11	0	2	1,779
11 Nov.	10	16	1	5	3	0	0	25
Total	6,507	10,843	584	2,425	166	14	8	14,040

Table 11. Angling methods and gear types used by anglers interviewed on the South Fork Boise River, 1977 and 1978.

	Winter whitefish season	General trout season
Fishing method		
Bank	45.1%	19.8%
Wade	54.9%	73.9%
Boat	0	6.3%
n	508	1,139
Rod type		
Fly rod	41.4%	80.6%
Spinning rod	58.6%	19.4%
Other	0	0
n	290	1,099
Lure type		
Artificial fly	43.5%	87.0%
Artificial lure	1.0%	13.0%
Bait	55.5%	0
n	310	1,079

Residence of anglers using the South Fork has changed very little. However, a larger percentage of Idaho residents from areas other than Mountain Home or Boise fished the South Fork during the 1978 winter season (Table 12).

Slightly more than half of the anglers fishing the South Fork during the general trout season have purchased resident combination (hunting and fishing) licenses (Mate 1977, 1978). Approximately, 10.3% of the anglers had purchased non-resident licenses in 1978 compared with 6.8% in 1976 and 10.0% in 1977 (Mate 1977, 1978). The winter whitefish season attracts a different type of angler with 71.6% buying resident combination licenses. A larger percentage of the winter anglers are senior residents (Table 13). Mate reported the same results during the winter whitefish season 1 December 1976 to 31 March 1977.

Length Frequencies

The mean length of whitefish remained unchanged during three winters of creel census interviews (Fig. 2). The mean length was 345 mm (13.6 in) in 1973-74 (Beach 1975, 1976, 1977 and Mate 1978). Mountain whitefish in anglers' creels during the 1976 general trout season had a mean length of 337 mm (13.2 in) (Mate 1977). The mean length of whitefish sampled by electrofishing shows no significant difference when compared to harvested fish. This suggests that the harvest is representative of the whitefish population in this section of the river. Snorkel observations have noted the lack of whitefish smaller than 200 mm (7.9 in).

Mean total length of harvested rainbow trout has increased 30 mm (1.2 in) since 1974. Rainbow trout over 305 mm (12 in) taken by anglers in 1974 averaged 351 mm (13.8 in) total length (Beach 1975). Mate (1977) reported similar findings in 1976 with harvested rainbow trout averaging 343 mm (13.5 in) total length (Fig. 3). Average size of harvested rainbow trout increased to 370 mm (14.6 in) in 1977 (Mate 1978). The mean total length of harvested wild rainbow during 1978 was 381 mm (15.0 in). The percentage of harvested rainbow trout over 405 mm (16 in) has increased from 6.2% in 1974 to 26% in 1978.

The percentage of rainbow trout over 405 mm (16 in) in the 1974 angler harvest and during test angling in 1976, 1977 and 1978 has increased from 2.1% in 1974 to 8.6% in 1978 (Fig. 4). The percentage of fish caught under 305 mm (12 in) increased in 1978. Regulations specifically protect fish under 305 mm (12 in) and require anglers to release them unharmed. Snorkel observation confirms the relative abundance of sub-legal sized wild rainbow trout in the South Fork. As anglers continue their present trend of releasing most fish, recruitment to the trophy category will be enhanced. Overall mean length of rainbow trout has not changed significantly. As more trophy sized trout are being added to the population, smaller rainbow trout are also increasing in numbers. This recruitment of small wild rainbow trout is one indicator of spawning success. Increased catch rates of fish over 305 mm should result from the increased numbers of sub-legal fish present in 1978.

Rainbow Trout Spawning

Length Frequency of Spawners

The average size of female spawners during 1977 (Mate 1978) and1978 has remained unchanged at 378 mm (14.9 in) total length. The average size of sexually mature male spawners was 346 mm (13.6 in) in 1977 but decreased to 317 mm (12.5 in)

Table 12. Residence of anglers interviewed on the South Fork Boise River, 1 December 1977 to 30 November 1978.

Place of residence	Winter whitefish season		General trout season	
	Number	Percent	Number	Percent
Boise	163	53	625	58.9
Mountain Home	75	24.4	205	19.3
Other Idaho residents	68	22.1	165	15.5
Non-residents	2	<1	67	6.3
Total	308		1,062	

Table 13. License classes recorded during creel census interviews on the South Fork Boise River, 1 December 1977 to 30 November 1978.

License class Code	Title	Winter whitefish season Number	Percent	General trout season Number	Percent
01	Resident Combination	219	71.6	555	56.2
03	Resident Fishing	59	19.3	304	30.8
04 & 92	Senior Resident (age 65 and over)	17	5.6	12	1.2
07	Junior Resident Combination (age 14-17)	3	<1	8	<1
09	Junior Resident Fishing (age 14-17)	4	1.3	6	<1
22	Non-Resident Season Fishing	1	<1	37	3.7
23	Non-Resident Fishing (7 day)	1	<1	39	4.0
24	Non-Resident Fishing (1 day)	0	0	26	2.6
95	Blind	1	<1	0	0
		306		987	

in the 1978 sample (Fig. 5). An increase in numbers of small males, 200-300 mm (7.9-11.8 in) found in the spawning areas caused the decrease in mean length for 1978. This increase of smaller males corresponds to the increase in 2-year olds found in the fishery and may point to a larger spawning population becoming available in the next few years.

The minimum size requirement is not protecting the female spawners in their first spawning season. To fully optimize spawning the minimum size requirement could be increased to protect first time spawners.

Spawning Location and Criteria

Rainbow spawning occurred from early April through the end of May for both 1977 and 1978 with the peak of activity 1 May.

Two locations were noted as having large concentrations of spawners; 1.6 km (1 mi) below Cow Creek Bridge and 0.8 km (0.5 mi) above and below Rock Creek. These areas are characterized by braiding (side channels) which was found to provide the substrates and water velocities best suited for spawning rainbow (Mate 1977). Water velocity and water depth were measured on redds in the main river during spawning for 1977 and 1978. Mean spawning preference for depth was 27.1 cm (10.7 in) with a range of 10 to 60 cm (3.9 - 23.6 in) (Fig. 6) and for velocity was 0.55 m/s (1.8 fps) with a range of 0.15 to 1.07 m/s (Fig. 7) (Mate and Cadwallader 1978). These spawning criteria are within the ranges found for rainbow by other investigators (Stalnaker and Arnette 1976). Low river flows, 5.5 m^3/s (195 cfs), which occur during the first 3 to 4 weeks of spawning due to reservoir management, leave most side channels dry. This results in redd superimposition and the use of areas with marginal gravels, up to 10 cm (3.9 in) in diameter, indicating spawning habitat is limited at these low flows (Wade et al. 1978). After the reservoir fills and river flows increase in May, spawners move into the previously dry side channel areas.

An increase in flow to 17 m^3/s (600 cfs) would provide access to the many side channels with abundant spawning habitat. Present management of Anderson Ranch Dam results in low flows during the peak of spawning with high flows due to spilling for the late May period. This was especially true during 1978, a "normal" water year. The 17 m^3/s proposed as minimum flows from 1 April to 31 August should provide adequate spawning and rearing habitat to help sustain and improve the South Fork rainbow fishery.

Tributary Spawning

Because of the limited spawning gravels available in the main channel of the South Fork Boise River, the many small tributaries entering the river are important spawning areas for trout (Fig. 1). Most of the tributaries have moderate to steep stream gradient. Generally those streams entering the South Fork from the north have the steepest gradients. No one tributary provides the bulk of spawning habitat although several could be improved to provide as much habitat as now available in all of the streams.

In 1977, a drought year with very low or nonexistent tributary flows, it was theorized that the tributaries were not significant in providing spawning habitat. However, in 1978, a more "normal" water year, substantial spawning took place in the tributaries. Both years had similar main channel South Fork flows during the spawning

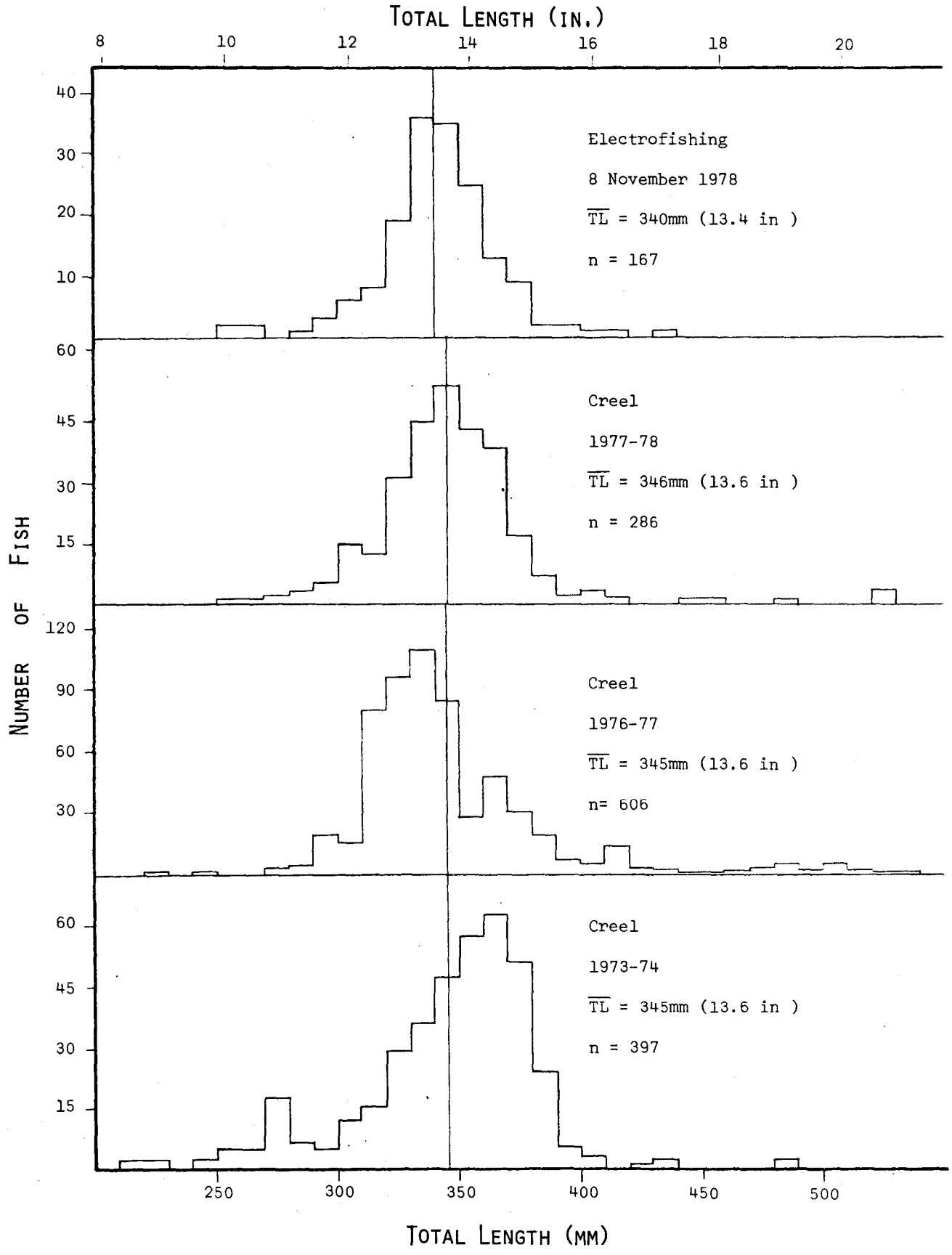


Figure 2. Length frequencies of mountain whitefish taken by electrofishing 8 November 1978 and sampled from angler creels during the winter whitefish seasons, 1 December to 31 March 1974-1978, South Fork Boise River from Anderson Ranch Dam to Danskin Bridge. Mean total length is shown by a vertical line through the graph.

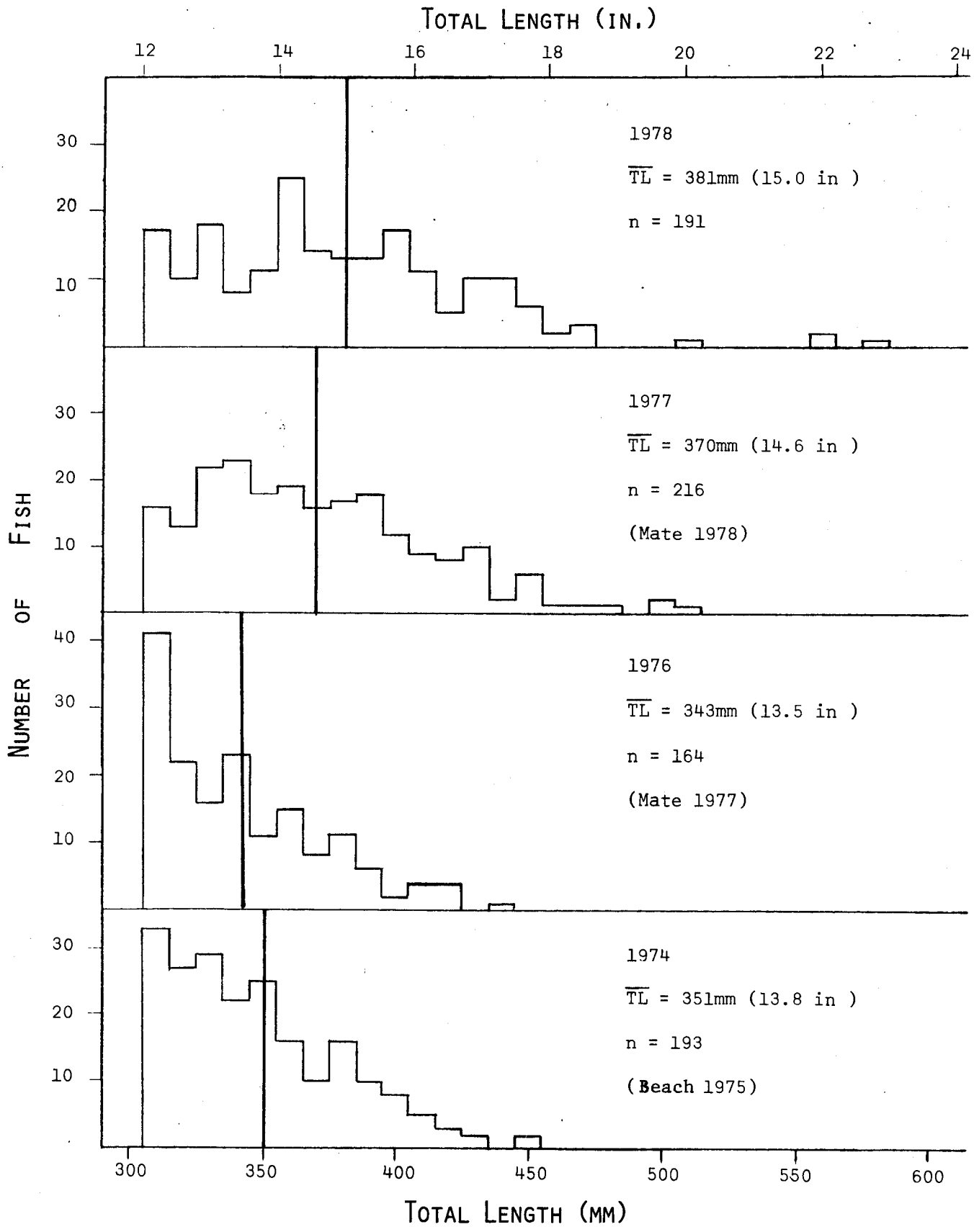


Figure 3. Length frequencies of wild rainbow trout sampled from angler creels during the general trout seasons 1974 to 1978,at the South Fork Boise River from Anderson Ranch Dam to Neal Bridge.The vertical line represents mean total length.

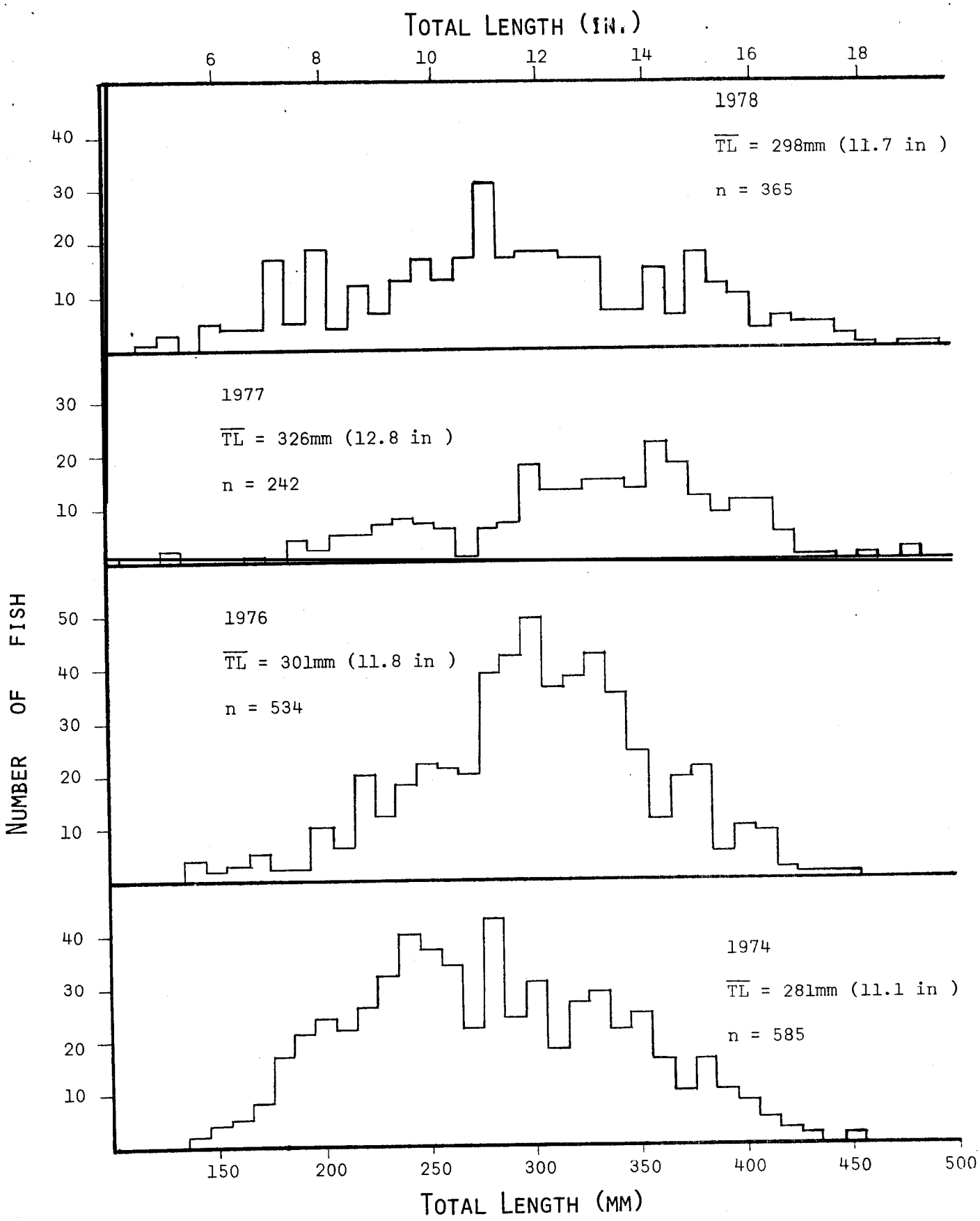


Figure 4. Length frequencies of wild rainbow trout sampled from the angler creel in 1974 and by test angling, 1976-78, at the South Fork Boise River from Anderson Ranch Dam to Neal Bridge.

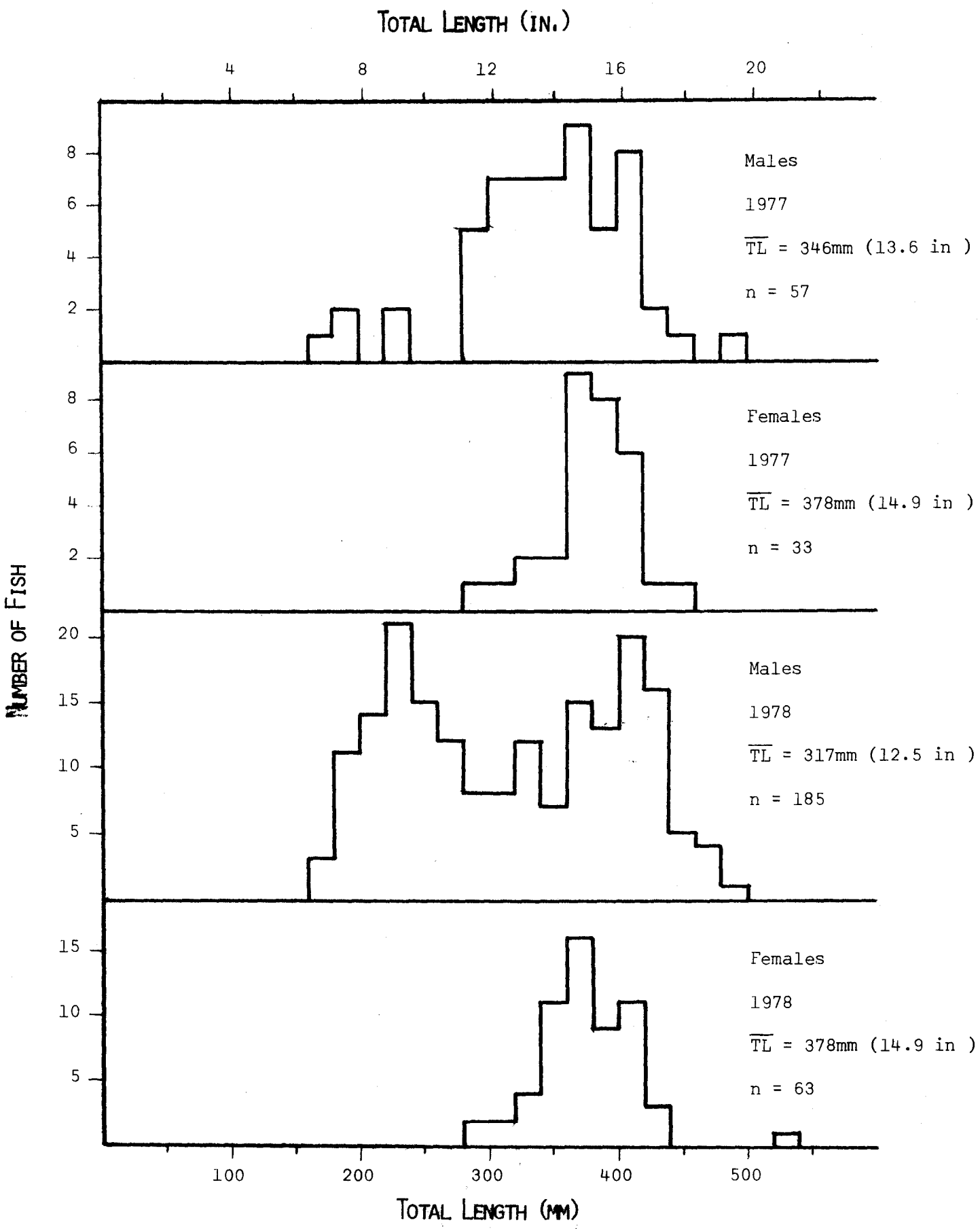


Figure 5. Length frequencies of sexually mature rainbow trout sampled from spawning grounds during April and May 1977-78 at the South Fork Boise River and tributaries below Anderson Ranch Dam.

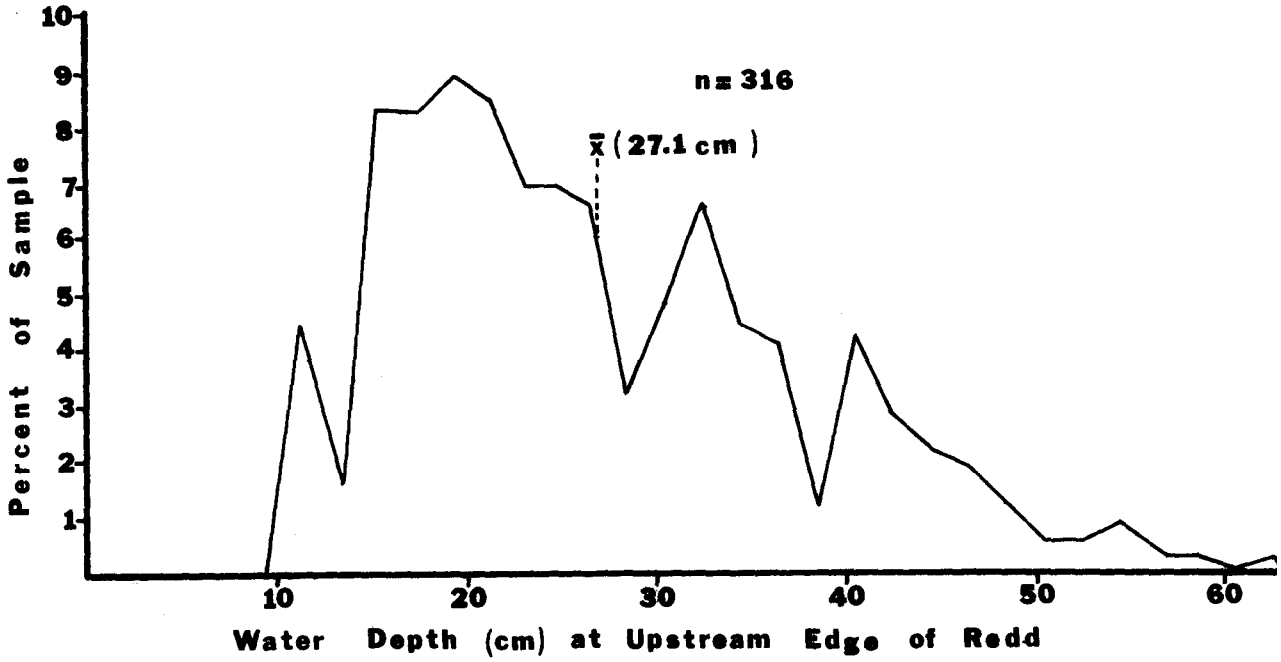


Figure 6. Rainbow trout spawning criteria as water depth measured at the upstream edge of redds during April 1977 and 1978 for the South Fork Boise River. Flows at 5.5 m^3/s.

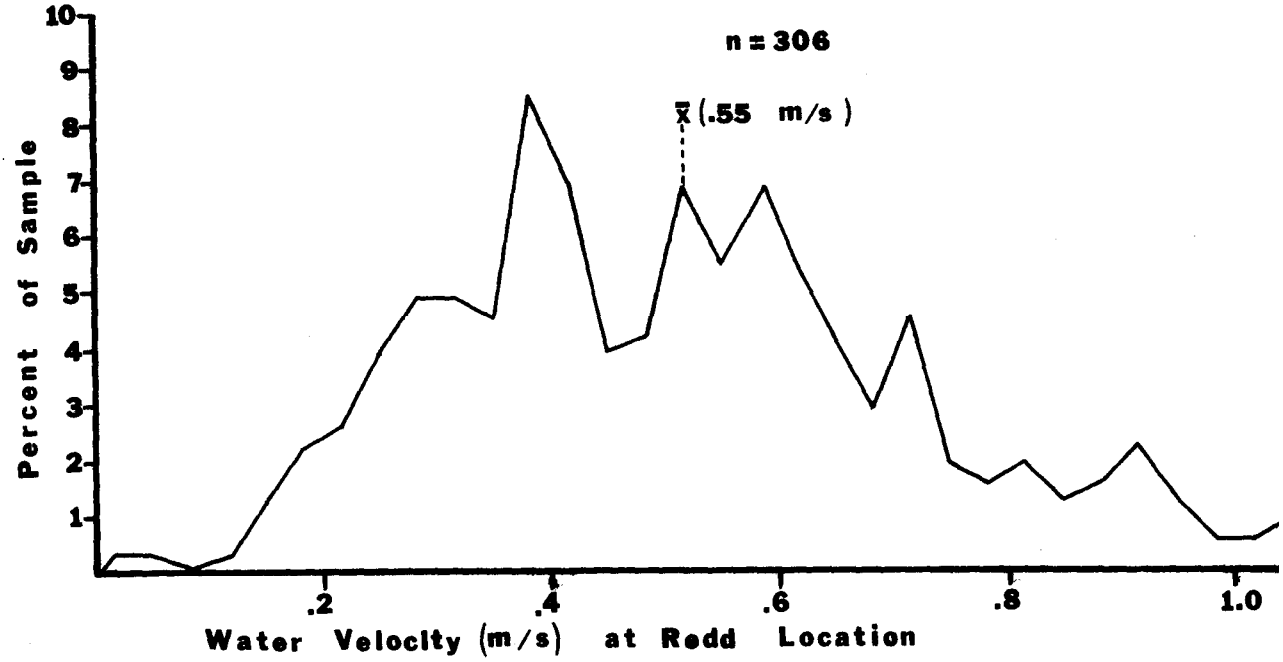


Figure 7. Rainbow trout spawning criteria as water velocity measured 0.3m above the upstream edge of redds at 12cm above the stream bottom during April 1977 and 1978 at the South Fork Boise River. Flows at 5.5 m^3/s.

period.

Some South Fork tributaries are degrading main river spawning bars by addition of heavy loads of fine sand and silt from disturbed watersheds. Three tributaries (Dixie, Rock and Cow Creeks) are noted for coloring the entire South Fork below their mouths during periods of high runoff. The combination of road building and maintenance, agriculture, grazing and logging seriously degrades the stability of small tributaries to the South Fork, ultimately affecting spawning habitat and productivity of the main river.

Description of Tributary Streams

Rough Creek

The smallest South Fork spawning tributary is Rough Creek located at river km 49.6 (mi 30.8). Rough Creek has a moderate gradient, allowing fish passage for approximately 0.8 km (0.5 mi) upstream from its mouth. No signs of severe runoff are evident in Rough Creek, probably because it is a relatively short and spring fed drainage. In 1977, drought induced low flows restricted fish passage into Rough Creek, resulting in only a small number of spawners successfully negotiating the stream. In 1978, more normal runoff provided better passage conditions which allowed an estimated 100 rainbow females to spawn. Rough Creek has adequate spawning gravels; however, its limited cover for adult fish results in predation at higher levels than occurs in larger tributaries. The stream is also heavily clogged with dead trees and brush which impede fish passage. The stream has good potential for stream improvement work to enhance passage conditions and to provide holding pools for spawning adult rainbow.

Cow Creek

Cow Creek is another small South Fork tributary that enters from the south at river km 48.3 (mi 30.0). Low flows in 1977, combined with beaver activity near the mouth, impeded fish passage. Concentrations of spawners were observed at the stream mouth. In 1978, higher flows passed spawners about 1.6 km (1 mi) upstream to a natural migration barrier. We estimated that 150 rainbow females spawned in Cow Creek in 1978. Obstacles to successful reproduction include lack of sufficient holding water for adults, limited bank cover and heavy silt accumulations. Cow Creek is paralleled by a county gravel road from which large amounts of fines are graded directly into the stream during road maintenance operations. Heavy concentrations of cattle in the watershed have reduced riparian vegetation and contributed to bank damage. The poor condition of the watershed, combined with the relatively steep stream gradient, cause considerable bank erosion at times. During periods of high runoff, turbidity from Cow Creek discolors the entire South Fork below its mouth. Some improvement in spawning conditions could be brought about by stream improvement work designed to provide more holding water for adult spawners. However, without changes in grazing and road maintenance procedures, the stream will continue to be a marginal spawning area that can be expected to provide little in fry recruitment to the South Fork.

Cayuse Creek

Cayuse Creek is similar in size and gradient to Cow Creek, paralleling it and entering the South Fork at River km 45.6 (mi 28.4). Cayuse Creek also has a natural migration barrier about 1.6 km (1 mi) upstream from its mouth. Cayuse

Creek is less heavily grazed and has no parallel road and therefore provides a much better environment for reproduction than Cow Creek. We estimated that a dozen spawning females were in Cayuse Creek in 1977 and 100 females in 1978. A moderate stream gradient and heavy bank cover provides reasonable good spawning habitat. Stream improvement work designed to increase holding water for adults and clearing of debris that retards passage would improve spawning success.

Granite Creek

Granite Creek is a medium sized South Fork tributary that enters the South Fork from the north at river km 44.4 (mi 28.1). A steep gradient at its mouth is a partial migration block to spawning rainbow at both high and low tributary flows. We estimated that less than 30 female spawners entered Granite Creek in both 1977 and 1978. A number of other possible natural migration barriers are evident in the initial 0.8 km (0.5 mi) above the stream mouth. These barriers are caused by a combination of the steep stream gradient and large boulders in the stream bed. Considerable spawning and rearing habitat is present upstream from this area but extensive stream improvement work would be necessary to improve passage for spawners.

Pierce Creek

Pierce Creek is one of the larger South Fork tributaries and enters the South Fork at river km 42.6 (mi 26.5) from the north. Pierce Creek is a steep gradient stream subject to severe runoff at times. We estimated that 100 rainbow female spawners used Pierce Creek in 1977 and 200 in 1978 when higher flows allowed better passage conditions. Passage is somewhat restricted in the stream from the county road culvert to the mouth due to channel modifications and culvert washouts in past years. About 0.8 km (0.5 mi) upstream from its mouth, Pierce Creek receives great amounts of silt and rock from severe gully erosion. This erosion is caused by improperly installed road culverts on the Smiths Prairie grade which climbs the canyon adjacent to Pierce Creek. Large deposits of fines are evident at the mouth of Pierce Creek, undoubtedly degrading main channel spawning habitat farther downstream. Modifications of existing culverts above Pierce Creek, changes in road maintenance procedures and erosion control could vastly improve spawning habitat. Stream improvement work near its mouth could improve passage conditions for spawners. Cleaning up the county road problems would allow Pierce Creek to realize its potential as one of the best spawning tributaries (capable of providing spawning habitat for many more fish). Spawning habitat downstream in the main river would also benefit.

Mennecke Creek

Mennecke Creek enters the South Fork from the south at river km 40.5 (mi 25.2). We saw no spawners in the stream in 1977 when its entire flow was diverted for irrigation, but estimated 100 rainbow females in 1978 when higher flows and a later irrigation season improved passage. Mennecke Creek is passable to spawners for about 3.8 km (2.3 mi) upstream from its mouth. However, a series of beaver dams about 0.8 km (0.5 mi) upstream are negotiable only at very high flows. An unscreened irrigation diversion removes most of the flow of Mennecke Creek when it is in operation. The diversion begins operation in May or early June, causing maximum damage to the spawning adults as they drop back downstream and to fry moving downstream later in the summer. Upper Mennecke Creek probably has more potential spawning habitat than any other South Fork tributary with its moderate gradient and ample gravel. However, lack of streambank vegetation (attributable to heavy cattle use of the stream bottom) and vehicle damage at numerous jeep road crossings

encourage severe bank erosion. Washed out stream improvement structures point to the futility of stream improvement without associated watershed protection. As most of the watershed is public land (U.S. Forest Service), efforts should be made to reclaim the upstream spawning habitat and provide mechanical screening for the irrigation diversion. Properly managed, Mennecke Creek could provide as much spawning habitat as all the South Fork tributaries provide now.

Bock Creek

Bock Creek is another South Fork tributary plagued by irrigation diversion losses. It is a small tributary entering the South Fork at river km 38.2 (mi 23.8) from the south. Irrigation diversions about 0.4 km (0.25 mi) up from its mouth cause losses of both adult spawners and newly hatched fry into an adjacent pasture. We estimated 100 female rainbow spawners in 1978 and no successful passage in 1977 when the entire stream was diverted. Bock Creek has no serious passage problems and had adequate spawning gravel. We noted spawners as far as 2.4 km (1.5 mi) upstream from the mouth in 1978, passage finally being impeded by the small size of the stream rather than any distinct natural barriers. Mechanical screening is needed to reduce losses at the irrigation diversion.

Rock Creek

Rock Creek is one of the larger South Fork tributaries and enters the main river at river km 37.8 (mi 23.5) from the north. It has a large delta area near its mouth where beaver activity splits the stream into several channels and impedes fish passage to an unknown degree. A few spawners were seen above the delta in 1977 and none in 1978. However, the large size and heavy turbidity of the stream make spawning observations difficult. Deer Creek, a tributary that joins Rock Creek about 0.8 km (0.5 mi) above its confluence with the South Fork, contains large deposits of fine sand and silt as a result of draining a large portion of the agricultural area of Smiths Prairie. Rock Creek, above the mouth of Deer Creek, is less turbid and does have excellent accumulations of spawning sized gravel, particularly in the stream section near where the county road crosses. No spawners were observed in the upper gravel areas, pointing to a migration blockage either at the delta or where the stream drops into the canyon, an area having large rubble and swift current. We noted no accumulations of fish below possible barriers or any definite natural barriers. Stream improvement work at the delta that was designed to confine the stream to a single channel could substantially improve passage to the lower portion of the stream. One irrigation diversion was noted in Rock Creek, but from appearance was not presently being used or large enough to be a serious problem.

Trail Creek

Trail Creek enters the South Fork from the south at river km 35.6 (mi 22.1) or just upstream from the South Fork Canyon. Estimates of female rainbow spawners range from 100 in 1978 to none in 1977 when most of the flow was diverted for irrigation. Spawners were noted up to 3.2 km (2 mi) above the mouth where stream size limits passage rather than any specific natural barrier. Although stream gradient is moderate, accumulations of debris make passage difficult at some locations and the stream generally lacks adult holding water. Stream improvement to create more pools and debris clearing from some areas could improve spawning conditions. Mechanical screening of the irrigation deversion is necessary to reduce losses of both adult spawners and newly hatched fry. Trail Creek is especially important as a spawning tributary because of its close proximity to the South Fork

Canyon where spawning habitat is very limited.

Smith Creek

Smith Creek enters the South Fork at river km 28.8 (mi 18). Smith Creek has a migration block that inhibits movement of spawners from the South Fork. However, there is a substantial resident trout population in Smith Creek.

Rattlesnake Creek

Rattlesnake Creek enters Arrowrock Reservoir from the north at river km 13.8 (mi 8.6), 1.1 km (0.7 mi) downstream from the high water mark of Arrowrock Reservoir. Passage for spawners appears viable for 16-24 km (10-15 mi) up Rattlesnake Creek and into a few smaller tributaries. In 1977, with Arrowrock Reservoir at minimum pool in late April, about 200 mature rainbow were concentrated at the mouth of Rattlesnake Creek. In 1978 the mouth was not accessible due to the reservoir pool, however, we observed a few spawning rainbow up to 6.4 km (4 mi) above the mouth. Rattlesnake Creek has a moderate to steep stream gradient with few holding pools. Pools are filled with fine sand and silt from upstream areas that have been intensively logged and roaded. Channel work associated with road washouts is adding to the instability of the streambed. With a minimum amount of stream improvement work and a great deal of watershed restoration work, Rattlesnake Creek would be an outstanding spawning stream, providing spawning and rearing habitat for resident rainbow. The contribution of rainbow from Rattlesnake Creek to the South Fork is unknown. There is a substantial wild rainbow population in Arrowrock Reservoir (Pollard, personal communication) which could be the source of spawners for Rattlesnake Creek.

Willow Creek

Willow Creek also enters the South Fork Arm of Arrowrock Reservoir. Willow and Woodtick, a major tributary have substantial resident wild trout populations as well as a spawning run in the spring.

Other Tributaries

Several very small spring fed tributaries may provide some spawning habitat under ideal flows, but the amount of habitat they provide is not significant compared to the tributaries already mentioned.

Age and Growth

Rainbow Trout

We analyzed scales from 183 wild rainbow trout from the South Fork. These rainbow ranged in age from 1+ to 5+, with the majority of the fish being in their fourth year of life (3+). The body-scale relationship is best expressed by the power model, total length = 6.74 $ASR^{\bullet 85}$, $r^2 = 0.84$ (Fig. 8). The plot of the linear model is shown for future reference. It was not used because of the lower r^2 value (0.79) and the over estimation of size at the first and second annulus. Mean lengths at time of annulus formation, calculated using the power regression relationship were 105 mm (4.1 in) for age 1, 193 mm (7.6 in) for age 2, 286 mm (11.3 in) for age 3, 357 mm (14.1 in) for age 4, and 414 mm (16.3 in) for age 5 (Table 14). Mean annual increment of growth was also calculated at 88 mm (3.5 in)

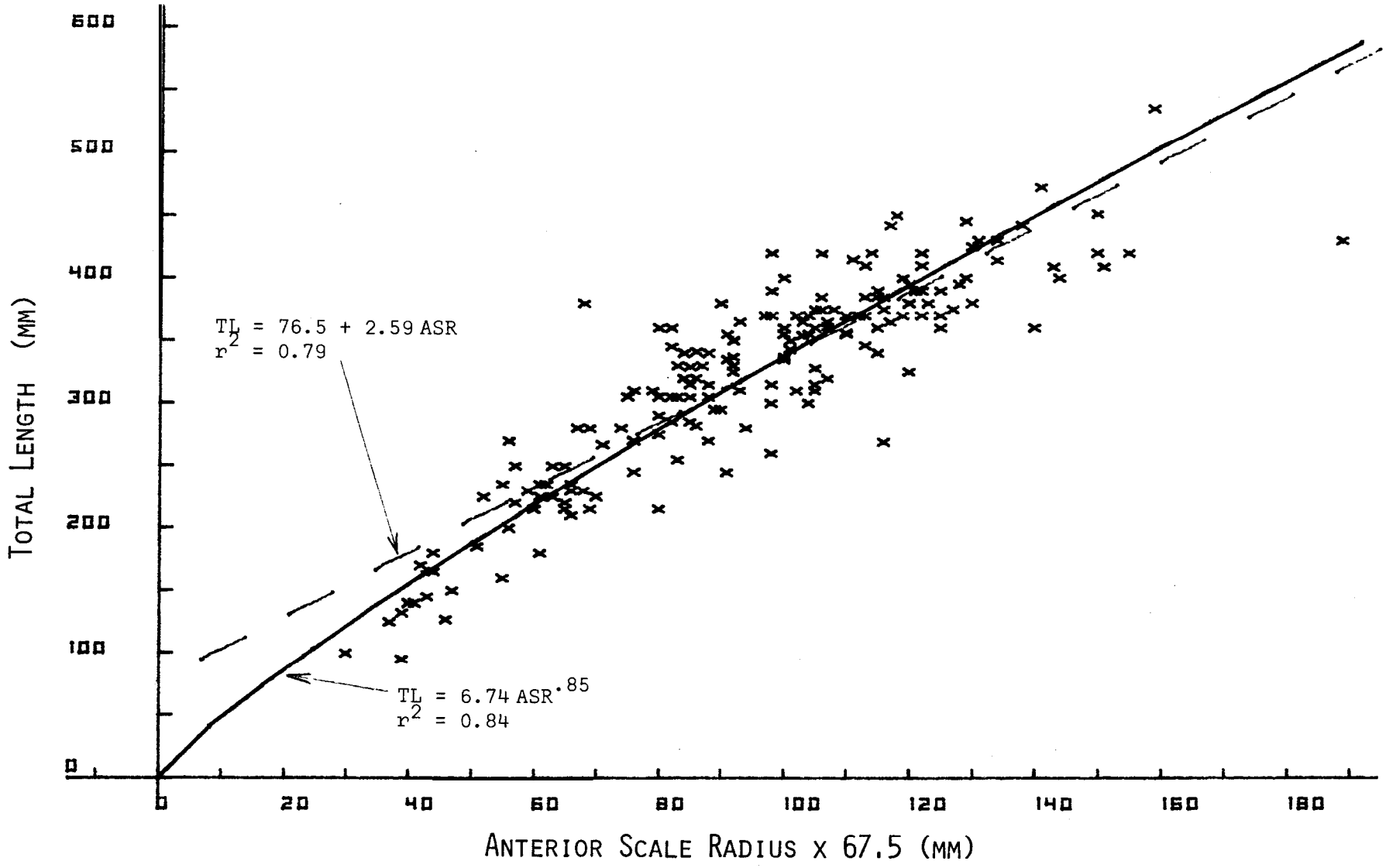


Figure 8. Anterior scale radius vs. total length for wild rainbow trout sampled during 1976-1978 from the South Fork Boise River , Anderson Ranch Dam to Neal Bridge. The linear regression model (TL = 76.5 + 2.59ASR) is shown for comparison with past data.

Table 14. Mean calculated total lengths and increment of growth for wild rainbow trout sampled from the South Fork Boise River, Anderson Ranch Dam to Neal Bridge, 1976-1978. Calculations made using total length (mm) = $6.75\,ASR^{.85}$, scales read at 67.5X .

Age class	Sample size	Calculated mean total lengths (mm) at annuls 1	2	3	4	5
1	10	121.2				
2	33	108.0	201.6			
3	72	97.7	195.3	292.3		
4	37	95.9	186.4	282.5	356.6	
5	23	102.0	187.6	283.7	358.0	414.0
Grand mean		105.0	193.2	286.2	357.3	414.0
Mean growth increments			88.2	93.0	71.1	56.7

from age 1-2, 93 mm (3.7 in) from age 2-3, 71 mm (2.8 in) from age 3-4, and 57 mm (2.2 in) from age 4-5. The lower annual growth increment after age 3 (or approximately 300 mm total length) corresponds with attainment of sexual maturity as indicated by the length frequency distribution of spawning rainbow (Fig. 5).

Several rainbow over 500 mm (19.7 in) were caught in the South Fork during 1978 with the largest recorded being 595 mm (23.5 in). Assuming continuation of constant annual growth after initial spawning (age 3), the predicted mean total length for age 6 is 471 mm (18.5 in) and for age 7 is 528 mm (20.8 in). Five fish in the aging sample, collected in late summer after a portion of the sixth year's growth was completed, averaged 460 mm (18.1 in).

Catch curves indicate mortality has decreased since the inception of special regulations. This has resulted in the appearance of the older, larger rainbows now found in the river. As mortality continues to decrease or population size increase, more of the 500 to 600 mm fish (19.7 to 23.6 in) can be expected in the fishery. Whether this population of rainbow in the South Fork Boise River is capable of producing fish even older and larger than present maximum is not known.

Mountain Whitefish

Whitefish scales were examined from 90 of 136 samples available from 1977. Whitefish ages ranged from 2+ at 230 mm (9.1 in) to 10+ at 465 mm (18.3 in). The body-scale relationship was best expressed by the linear regression model, total length (mm) = 97.45 + 2.75 ASR with $r^2 = 0.80$ (Fig. 9). Maximum growth rate occurred during the first 2 years of life, declining in the third to a nearly constant rate from ages 4 through 9 (Table 15). The majority of the fish were age 5+ with only three fish showing more than 8 years of growth. Whitefish from the North Fork Clearwater River and the Logan River, Utah show nearly identical age and growth patterns as the South Fork Boise River fish (Pettit and Wallace 1975, Sigler 1951). Since our scale sample was deficient in fish younger than age 2, the back calculations to age class 1 may be biased slightly high.

During summer snorkel surveys we observed very few whitefish under 255 mm (10 in) in the South Fork. The length frequency distribution of harvested whitefish for the winter angling season (Fig. 2) is fairly representative of the population in the river as represented by our snorkel sample. Sexual maturity of South Fork whitefish is initially reached at 250 to 300 mm (10-12 in) total length. There is fast growth to age 3 and then merging of annuli, indicating very slow growth of adult fish.

The preceding factors are indicative of under-exploited whitefish populations that are seen in many Idaho rivers. They are characterized by large numbers of adult whitefish in the population, large spawning populations with low fry survival, and interspecific competition between adult whitefish.

Condition Factors

Condition factors (K) were calculated using: $K = w/1^3 \times 10^5$, where w=weight in grams and 1 = total length in mm. Rainbow trout sampled during the general season had a mean K of 0.99 with a standard deviation (S) of 0.10 and a range (r) of 1.20 to 0.85 (n=38). A trend of increasing K with length was evident but was

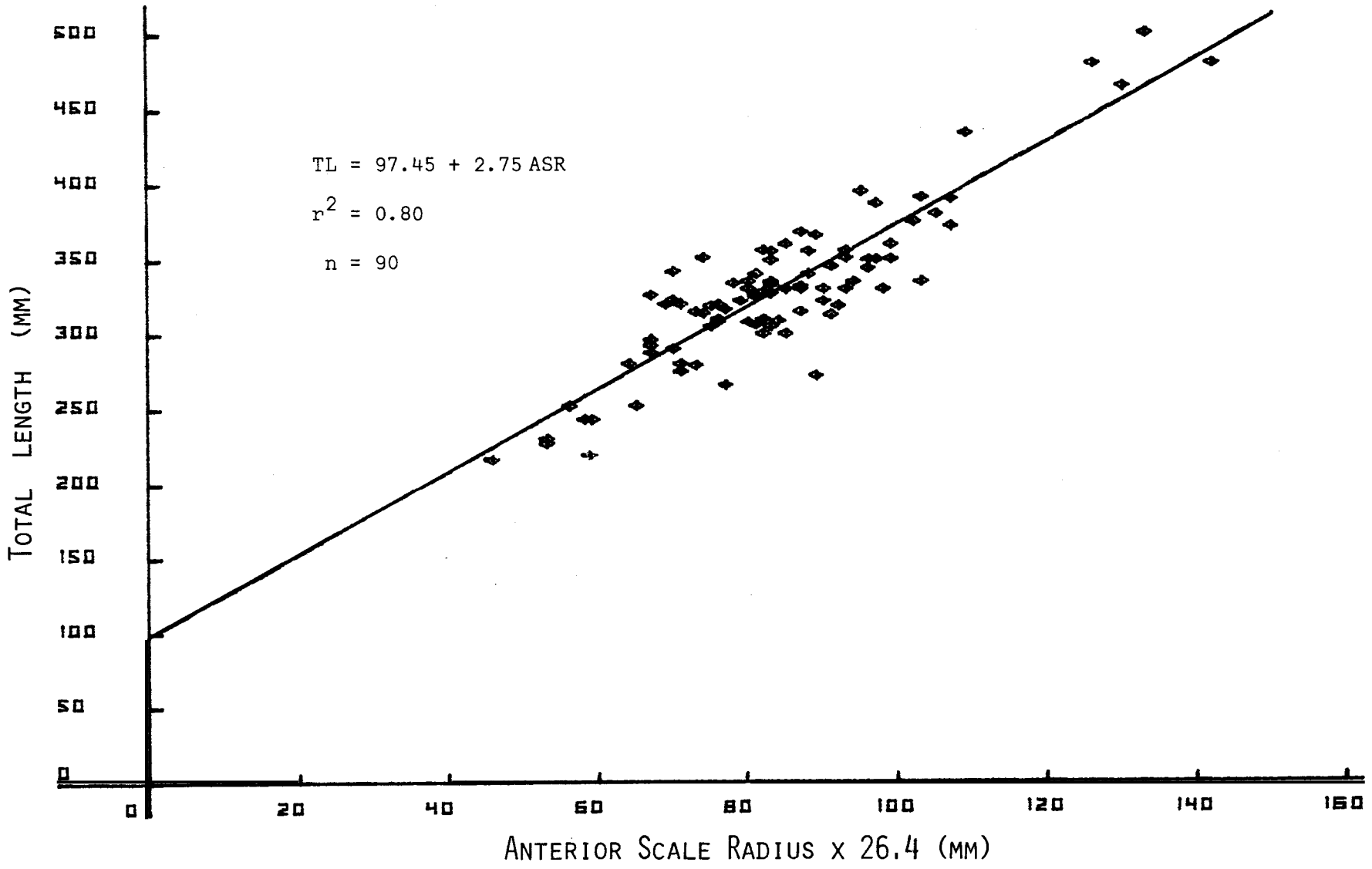


Figure 9. Anterior scale radius vs. total length for mountain whitefish sampled during 1977 from the South Fork Boise River from Anderson Ranch Dam to Danskin Bridge.

Table 15. Mean calculated total lengths and increment of growth for mountain whitefish sampled from the South Fork Boise River, Anderson Ranch Dam to Danskin Bridge, 1977. Total length = 97.45 + 2.75 ASR, R^2 = 0.80, scales read at 26.4 X.

Age group	Sample size	Calculated mean total length (mm) at each year of life									
		1	2	3	4	5	6	7	8	9	10
1	0										
2	8	163	245								
3	11	166	240	287							
4	17	155	228	285	302						
5	29	160	237	291	321	338					
6	16	160	233	276	306	327	341				
7	4	173	230	277	311	338	355	371			
8	2	152	242	282	315	334	367	397	412		
9	2				- no useful data -						
10	1	166	249	282	306	348	370	392	422	441	45
Grand mean		162	238	283	310	337	358	387	417	441	45
Mean growth increment		76	45	27	27	21	29	30	24	14	5

non-significant because of limited sample size. This trend is also reflected in the length weight cures (Fig. 10) which has an exponent greater than 3.0, $w = L^{3 \cdot 09} \times 5.91 \times 10\text{-}^{6}$ ($r^6 = 0.99$).

Mean K for mountain whitefish sampled during the spring and summer was 0.92 (s = .21, r = .70 - 1.16, n =148). For fish sampled just prior to spawning in November, mean K had increased to 1.06 (s=0.11, r = 0.90 - 1.25, n = 105). Immature whitefish did not show this increase in K with the onset of spawning. South Fork whitefish also display a loss of body condition as they get larger, perhaps due to intraspecific competition. The length-weight relationship for whitefish sampled during the spring and summer, 1977 was best expressed as w = L2.61 x 8.76 x l0-^{5} ($r^2 = 0.83$) (Fig. 11).

Fish Movement

Rainbow Trout

Movement data were obtained from 116 rainbow (17% of fish tagged) recaptured by anglers during 1976 through 1978. Since most of the angling effort and all the census work took place in the roaded portion of the South Fork (Danskin Bridge to Anderson Dam), the majority of the tag returns were from that area (Table 16). Of the rainbow which were tagged longer than 10 days, 54% displayed no movement (less than 1.0 km), 27% moved upstream, and 19% moved downstream (Fig. 12). The majority of rainbow movement which did occur was associated with spawning activities from mid-April through late May (Fig. 13).

The general seasonal movement of rainbows in the South Fork is still only partially documented. Mate (1978) reported an initial downstream movement of fry and then a fall migration upstream to near the dam, with winter holdover in that area. It appears that little movement of juvenile trout occurs once they become dispersed after winter holdover. The majority of movement is under 1.0 km (0.6 in) and 95% less than 13 km (8 mi).

It is not known whether homing and repeat spawning is occurring in South Fork tributaries. Few tags were recovered from tributaries during 1978 because of the small number of fish tagged in those streams in 1977, due to the drought. Recovery of tagged spawners during the 1979 spawning season should provide further knowledge.

The distance traveled by rainbow in the South Fork showed no correlation with time (Fig. 14). One fish was recaptured 28.7 km (17.9 mi) upstream in 1 month, while another was recaptured 17.4 km (10.8 mi) upstream after 2 years. The longest documented movement was a rainbow that had moved downstream out of the South Fork into Arrowrock Reservoir and then upstream into the Middle Fork Boise River. Total distance from point of tagging to the recapture site was 58.8 km (36.8 mi) over an 11-month period.

These findings may reflect a bias toward upstream moving trout. Only 5% of the angler effort occurs below Danskin Bridge and 65% of the rainbow tagged were in Section 3, (Danskin Bridge to Indian Rock). This may have resulted in proportionally fewer downstream migrants being recovered than upstream migrants.

Mountain Whitefish

Tag return data for South Fork whitefish indicates little (less than 1.0 km) or no

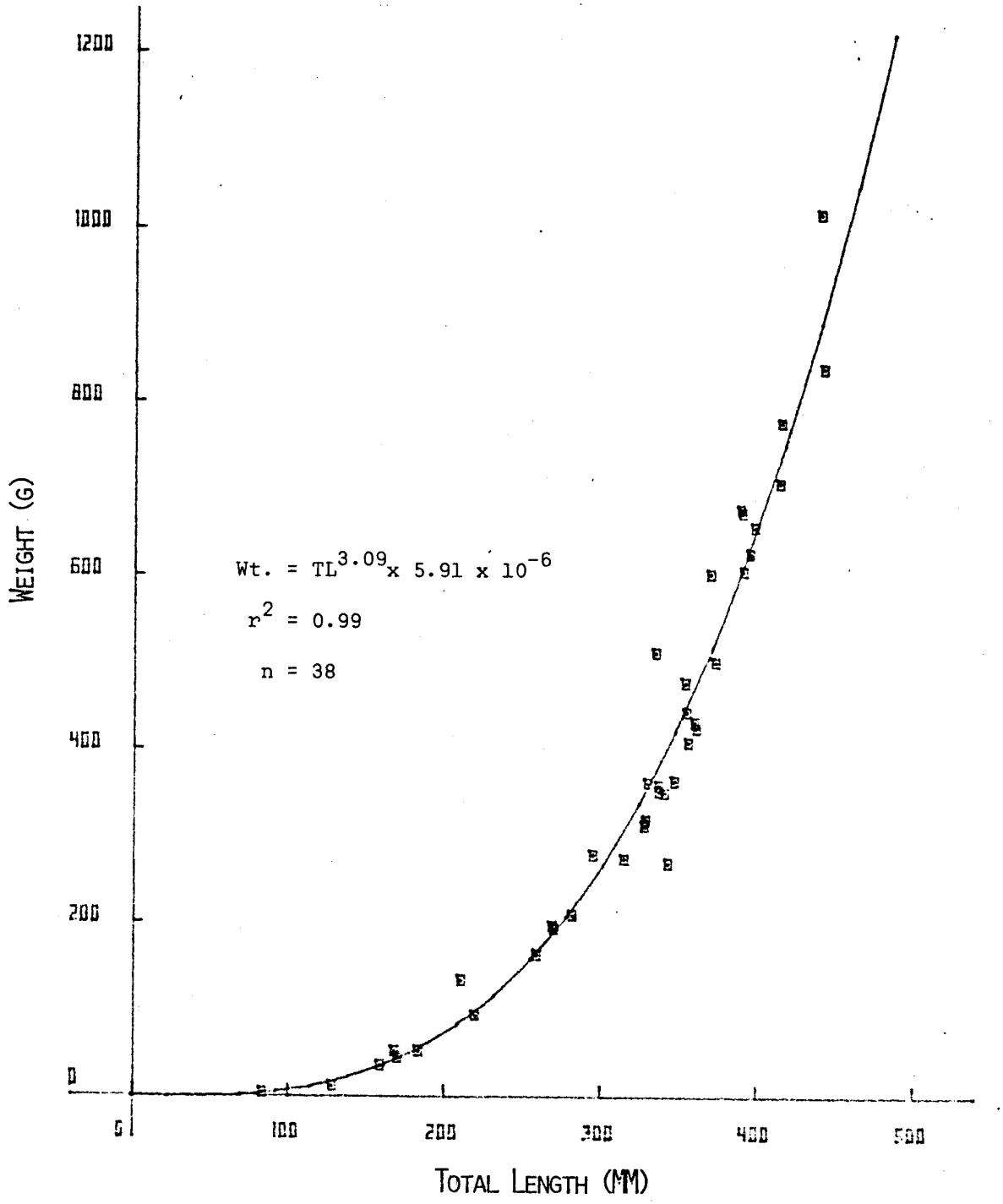


Figure 10. Length-weight relationship for wild rainbow trout from the South Fork Boise River, Anderson Ranch Dam to Neal Bridge, 1977-1978.

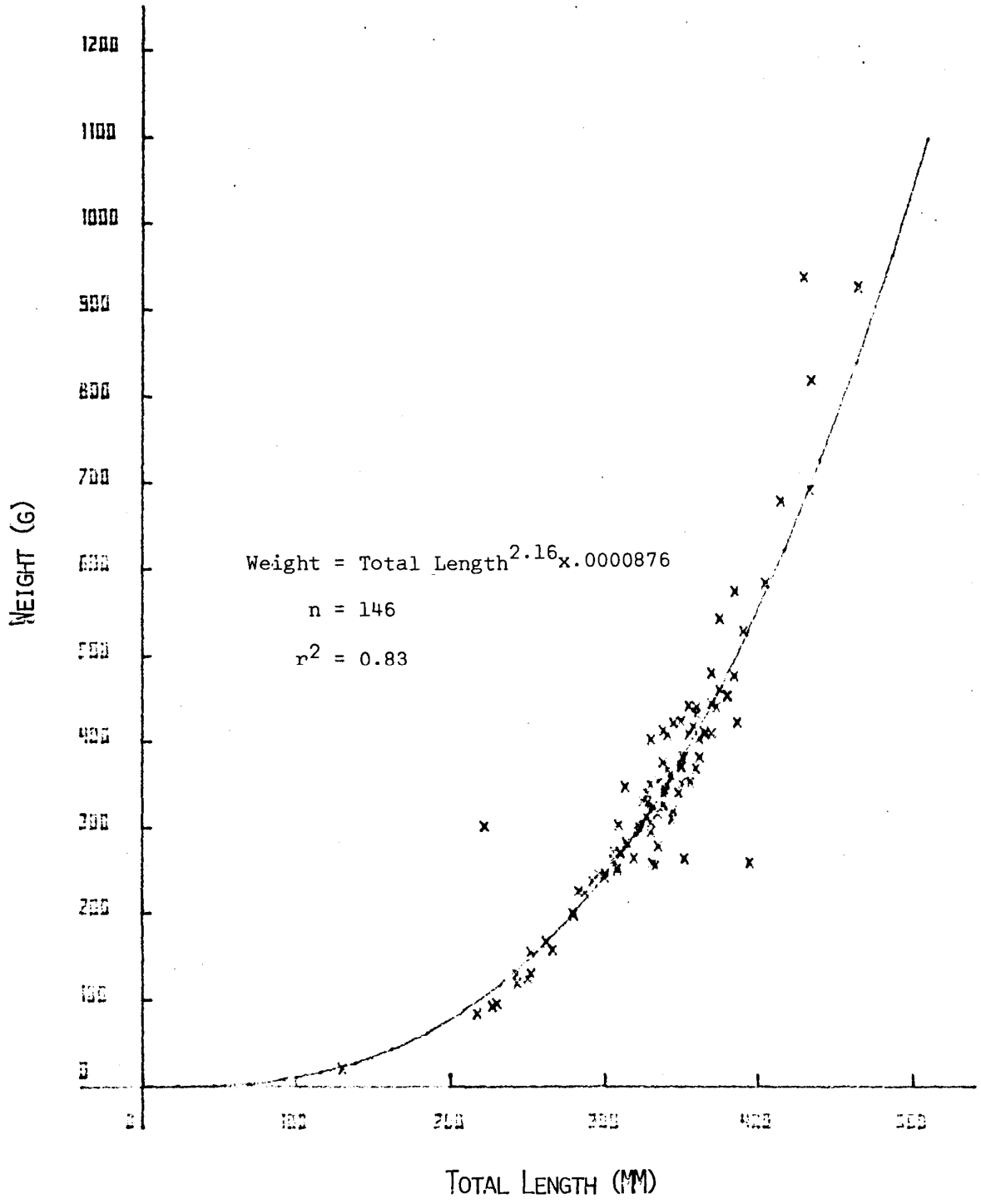


Figure 11. Length-weight relationship for mountain whitefish from the South Fork Boise River, Anderson Ranch Dam to Danskin Bridge, 1977-1978.

Table 16. Wild rainbow trout tagged in, and recaptured from, four sections of the South Fork Boise River, 1976-1978.

River section	No. tagged	No. recaptured	% return
Dam to Anderson Bridge	44 (6)[1/]	3 (3)[1]	6
Anderson Bridge to Indian Rock	69 (10)	13 (12)	18
Indian Rock to Danskin Bridge	441 (65)	83 (74)	18
Danskin Bridge to Neal Bridge	125 (19)	13 (12)	10
Totals	679 (100)	116 (100)	17

1/ % of totals

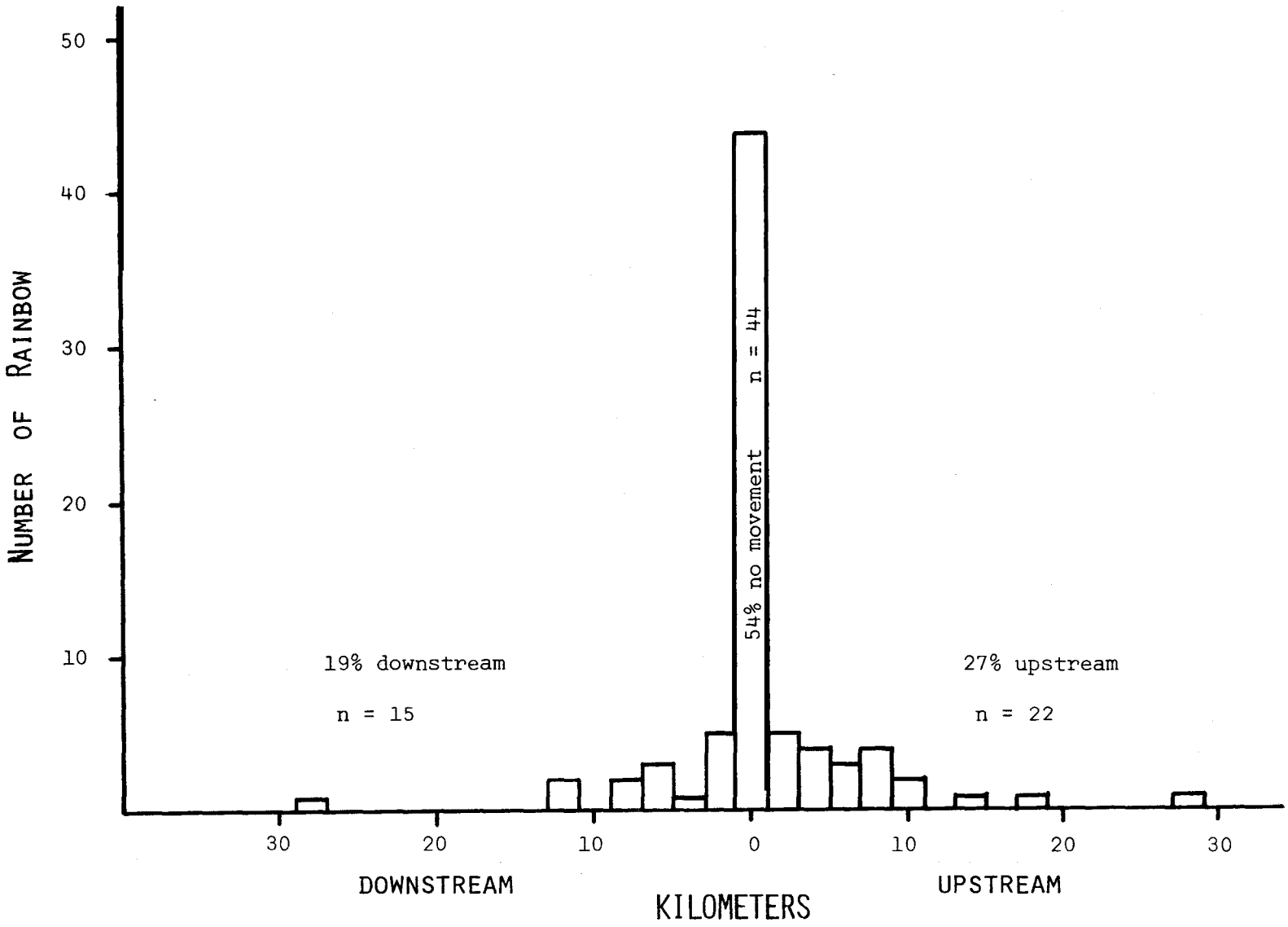


Figure 12. Frequency of movement for rainbow trout from point of tagging to point of capture in the South Fork Boise River below Anderson Ranch Dam, 1976-1978. Only those fish tagged 10 days or longer were used, n = 81.

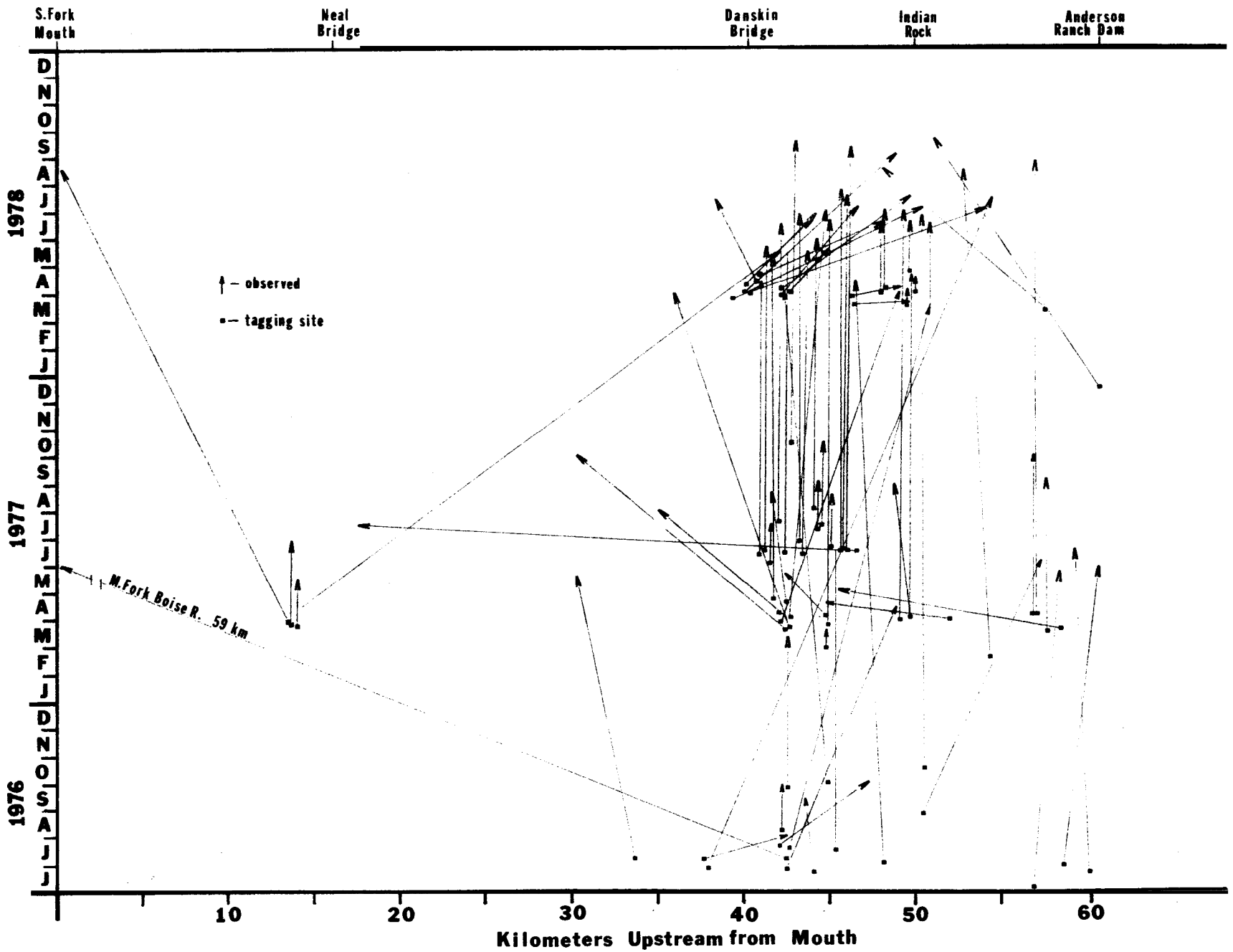


Figure 13. Movement of rainbow trout from point of tagging to point of capture in the South Fork Boise River below Anderson Ranch Dam, 1976-1978.

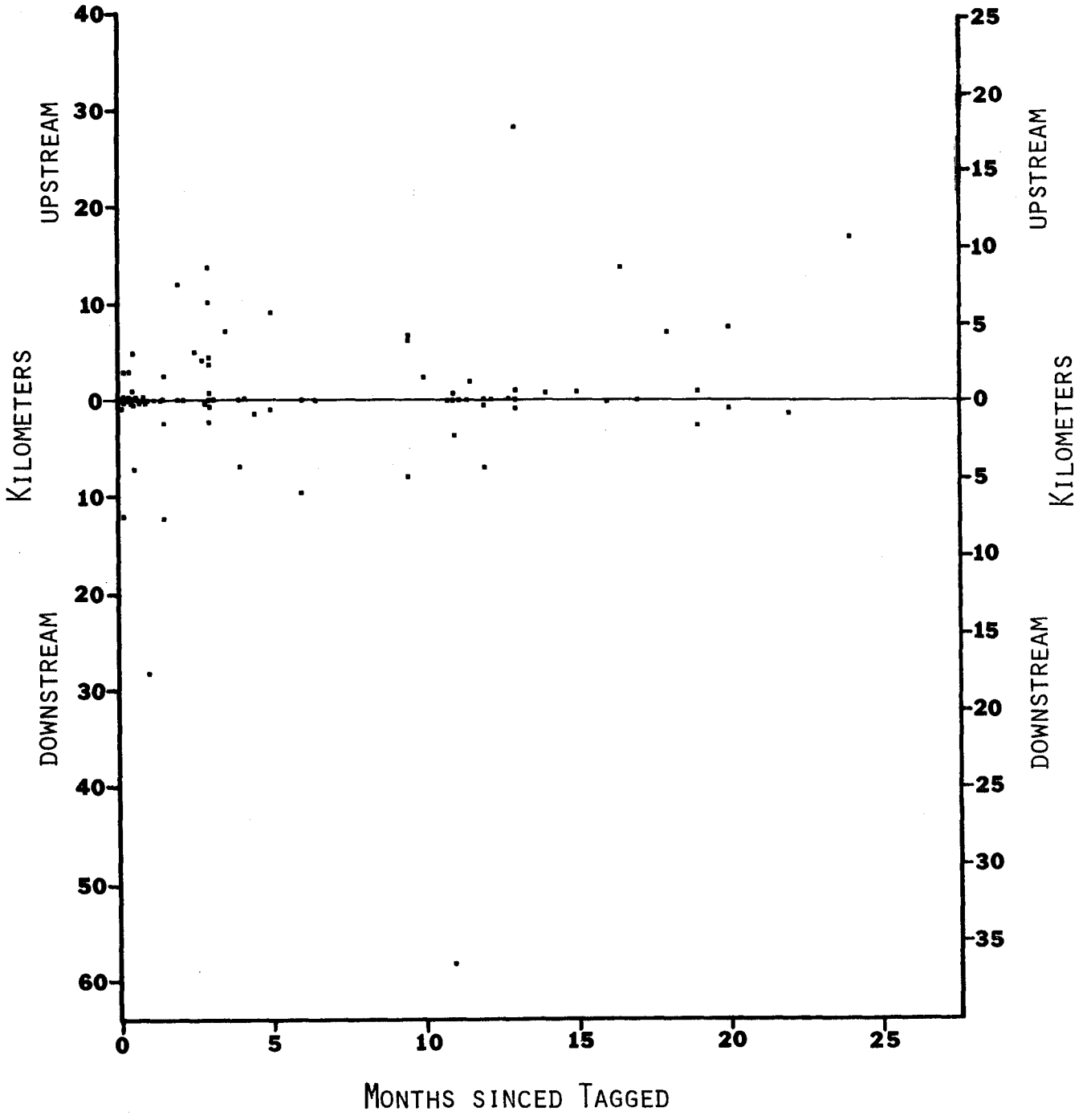


Figure 14. Time vs. distance traveled from point of tagging to point of capture for rainbow trout in the South Fork Boise River below Anderson Ranch Dam, 1976-1978. There is no correlation between time and distance traveled, n = 87.

movement in 71% of the cases documented over a 19-month period (Fig. 15). Low tag returns make conclusions difficult. A total of 379 fish were tagged and only 20 recaptures (5.4%) were made. Because of the large number of whitefish present in the river, a greater number of fish needed to be tagged to increase the tag returns in the creel. The majority of the recaptured whitefish exhibited no movement. Those that did move displayed no discernable pattern. Other investigators have found that whitefish generally show (1) general upstream movement with age (Jeppson 1970), (2) that movement related to spawning was minimal (MacAfee 1966), or (3) that definite seasonal migration patterns, both up and down stream occur, related to water temperature and spawning and that spawners home to the same areas previously used (Pettit and Wallace 1975).

Population Estimates

Snorkel Transects

Transect 1 (1.3 km above Anderson Bridge to Anderson Bridge) had the highest count of rainbow trout, a total of 359 rainbow trout or 276 trout/km (449 trout/mi) (Table 17). Individual counts for the two snorkelers were 187 and 172. Transect 2 (from Reclamation Village 1.9 km downstream) had the lowest count of 214 rainbow trout or 113 trout/km (178 trout/mi). Individual snorkel counts were 117 and 97. Transect 3 (1.6 km above Cow Creek Bridge to Bridge) exhibited the greatest difference between the two counters of 85 and 207 fish for a total of 294 rainbow or 184 trout/km (294 trout/mi). Eight-five fish were counted on the side of the river nearest the road while 207 fish were enumerated on the far side. Because of this discrepancy Transect 3 was resnorkeled and 117 trout were counted on the road side and 149 on the opposite side with a total of 266. This is only a 10% difference between the total count even though the individual counts varied more. The reduced number of fish on the roaded side in Transect 3 is probably due to angler activity being concentrated near the road. Within this transect, the road is right next to the river with little obstruction of view or access by vegetation. Transects 1 and 2 are further from direct access at most points.

Snorkeling seems to be a viable method of trout enumeration in the South Fork during low flows. However, it is only an index of abundance, not an actual population estimate due to the relatively small area of visibility compared to the size of the river. Counts of fish in the summer were not feasible because of limited visibility and the swiftness of flow at that time of year (Wade et al. 1978). For seasonal or annual comparisons, counts should be made on or near the same dates and at the same flow. Also the number of elapsed days following flow reduction could affect the counts because of fish movement.

We noted many dead fish in some of the deeper pools. We assume these were hooking mortalities, but they were difficult to recover in deep water. One dead trout, 400 mm (15.7 in), was recovered with a barbed-treble hooked spinner still attached.

Juvenile whitefish, age class I, were noted in 15 to 25 cm (6-10 in) of water at the tail of runs and pools just above the fast water of the riffle. This habitat appeared marginal with very little holding water out of the swift current. Whether this is the area that juvenile whitefish are using during their first summer of life is unknown. Juvenile whitefish had not been previously located (Wade et al. 1978).

Visibility during snorkel counts was limited due to suspended aquatic vegetation but was adequate for accurate counts. Visibility got progressively better downstream.

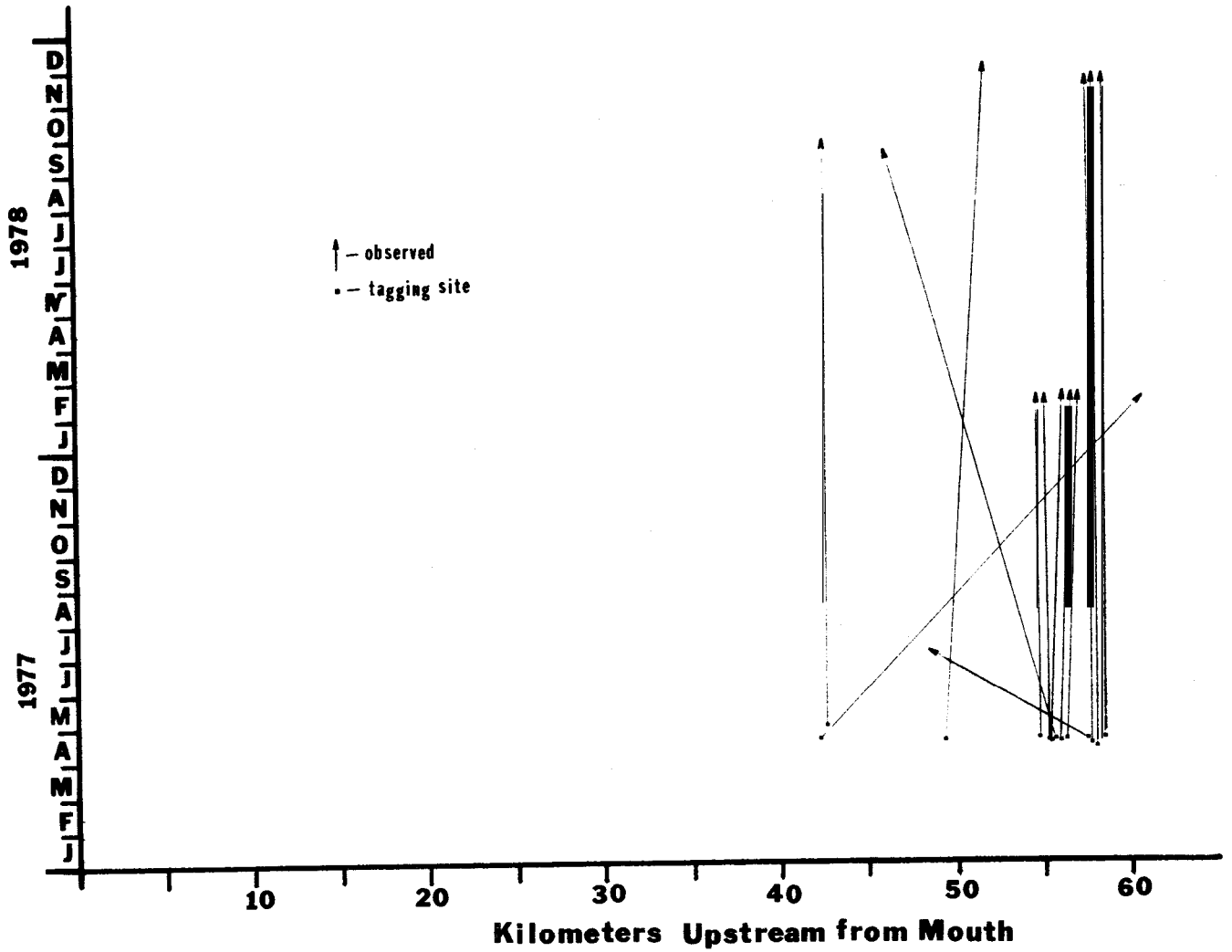


Figure 15. Movement of tagged mountain whitefish from point of tagging to point of capture in the South Fork Boise River below Anderson Ranch Dam, 1977-78.

Table 17. Number of trout counted in three snorkel transects from each creel census section, 3-6 October 1978.[1/]

Creel census section	Transect	Rainbow	Dolly Varden	Total	Fish/km (Fish/mi)
1	1.3 km (0.8 mi) above Anderson Bridge to bridge	359	0	359	276 (449)
2	From Reclamation Village boat ramp to 1.9 km (1.2 mi) downstream	214	0	214	113 (178)
3	1.6 km (1.0 mi) above Cow Creek Bridge to bridge [2/]	279	3	291	176 (281)

[1/] Water flows at 5.5 m^3/s since 5 September 1978.

[2/] Mean of two snorkel counts, the other 19 October 1978.

This may affect comparisons between transects in upper and lower sections.

Catch Rates

The best indicator of population trends presently available for South Fork rainbow comes from catch rates. Catch rates during the general season have increased from 0.64 rainbow/hr in 1974 to 1.64 rainbow/hr in 1978, a 2.6-fold increase (Fig. 16). This has continued to occur even though effort and catch is increasing. Catch rates of rainbow taken incidental to whitefish during the winter season have increased by 4.6 times from 0.024 rainbow/hr in 1972 to 0.11 rainbow/hr in 1978. Other investigators have found that increases in populations of trout after restrictive regulations resulted in higher catch rates (Chapman et al. 1973 and Bjornn 1975).

Future snorkel transect data should give better information in relation to the degree of increase in the South Fork rainbow population. Catch rates should continue to increase until the population stabilizes or angler effort increases past optimum levels. The fish which supported the major portion of this increase in 1978, were 2-year olds from the 1976 year class.

Mortality Estimates

Rainbow Trout

Total mortality coefficients (Z) have decreased since 1974 (Fig. 17). Using this change in Z and the effort expended for fish creeled during 1976-1978, the natural mortality coefficient (M) was found to be 0.48 (Fig. 18). All other mortalities were calculated from Z and M (Table 18).

Total mortality rates (1-S) for wild rainbow trout have decreased from 82% annually in 1974, prior to special regulations, to 67% in 1978. Fishing mortality has decreased from 59% in 1974 to 38% in 1978 (Table 18), illustrating the effects of reduced creel limits and fishing effort. These lower mortalities have resulted in the survival of rainbow into older age classes, thus increasing the mean size of fish in the creel. Lower mortality has also shifted the age of recruitment to the fishery from age 2 in 1974 to age 3 in 1976-78 (Fig. 19). Age 2 fish are composing more of the catch even though mortality has decreased. This is an indication that the special regulations that have protected smaller trout since 1976 are beginning to take effect. This is also supported by the increase in catch rate and slight decrease in mean size of rainbow in the 1978 catch and release fishery (Fig. 4).

As fishing mortality and total mortality have decreased, natural mortality has increased by 6% from 23% to 29% since inception of special regulations. This 6% increase could be due to the increase in catch and release fishing with its associated hooking mortalities. In a review of hooking mortality literature, Pollard (1979), found that hooking mortalities of salmonids caught with artificial flies ranged from 1.6 to 11.3% with most being around 4 to 5%. Natural mortality may also be increasing because of the presence of older fish which have not been removed by fishing. No rainbow large enough to be older than age 5 were found in the South Fork fishery during 1974 and 1976, but several fish large enough td be of age 6 and 7 were measured during 1977 'and 1978.

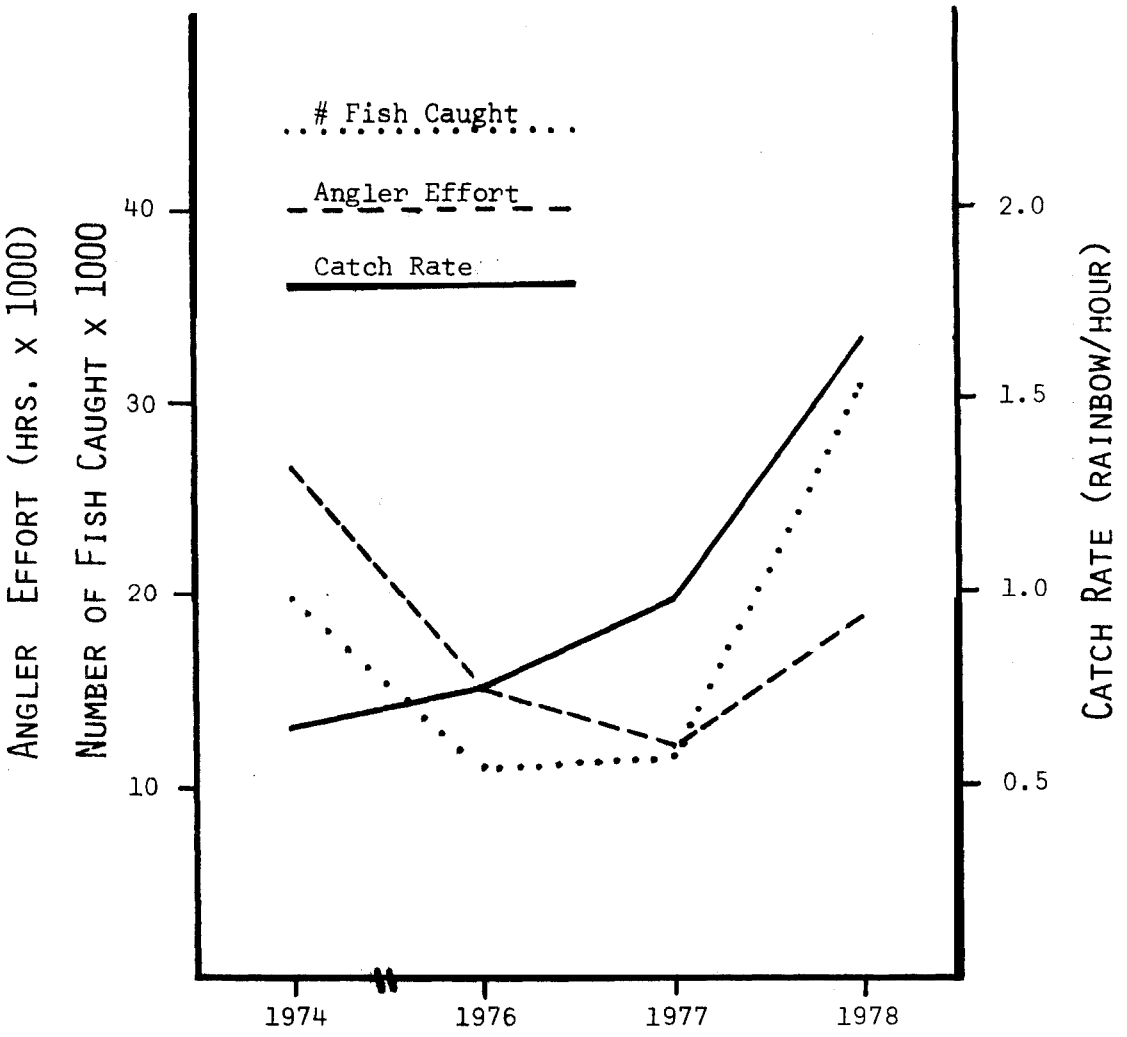


Figure 16. Trends in numbers of fish caught, angler effort, and catch rates for rainbow trout from the South Fork Boise River, Anderson Ranch Dam to Danskin Bridge, 1974-1978. Rainbow caught includes those fish creeled and caught and released.

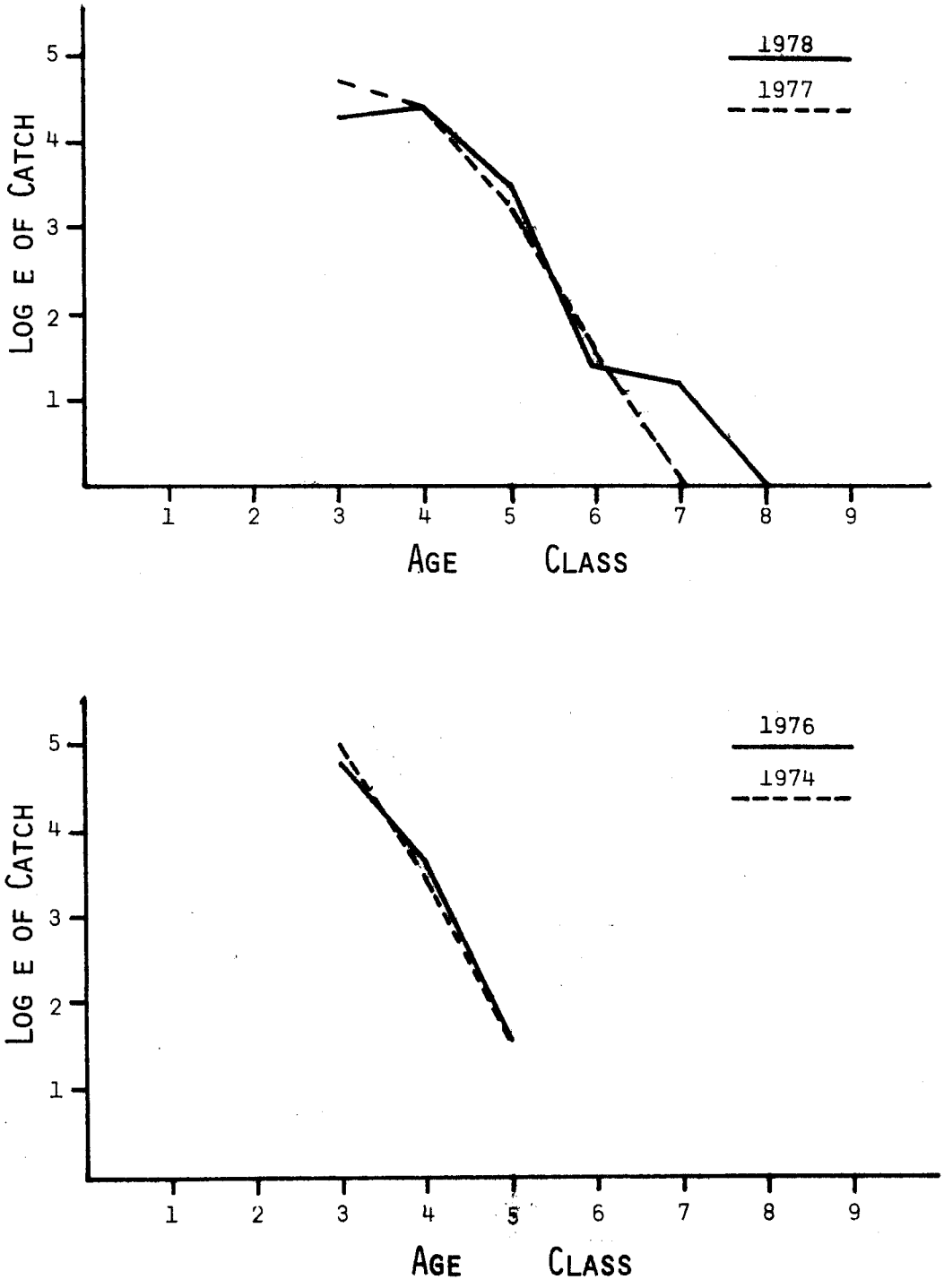


Figure 17. Catch curves for creeled wild rainbow trout from the South Fork Boise River below Anderson Ranch Dam, 1974-1978. Ages 7, 8, and 9 were estimated from age growth extrapolations.

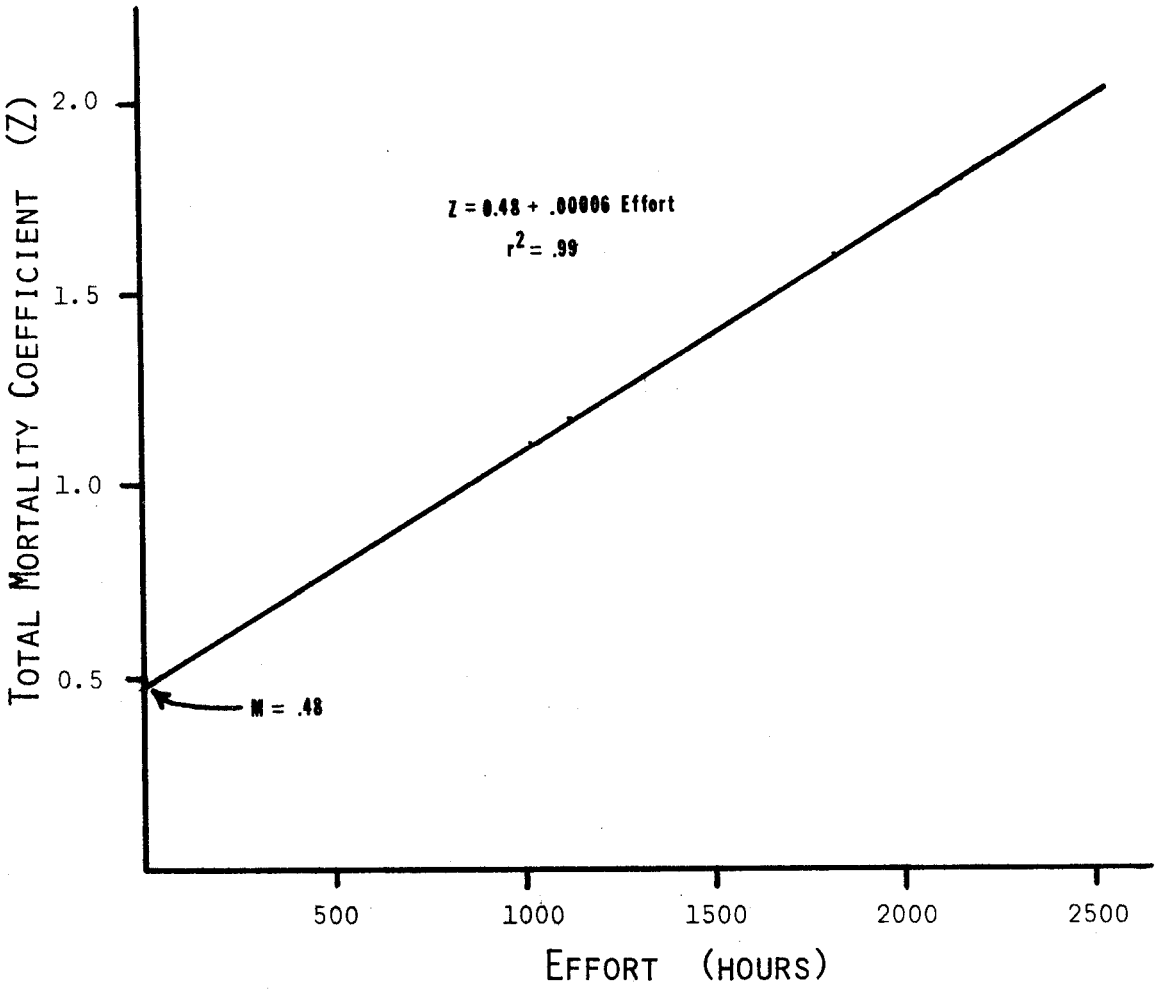


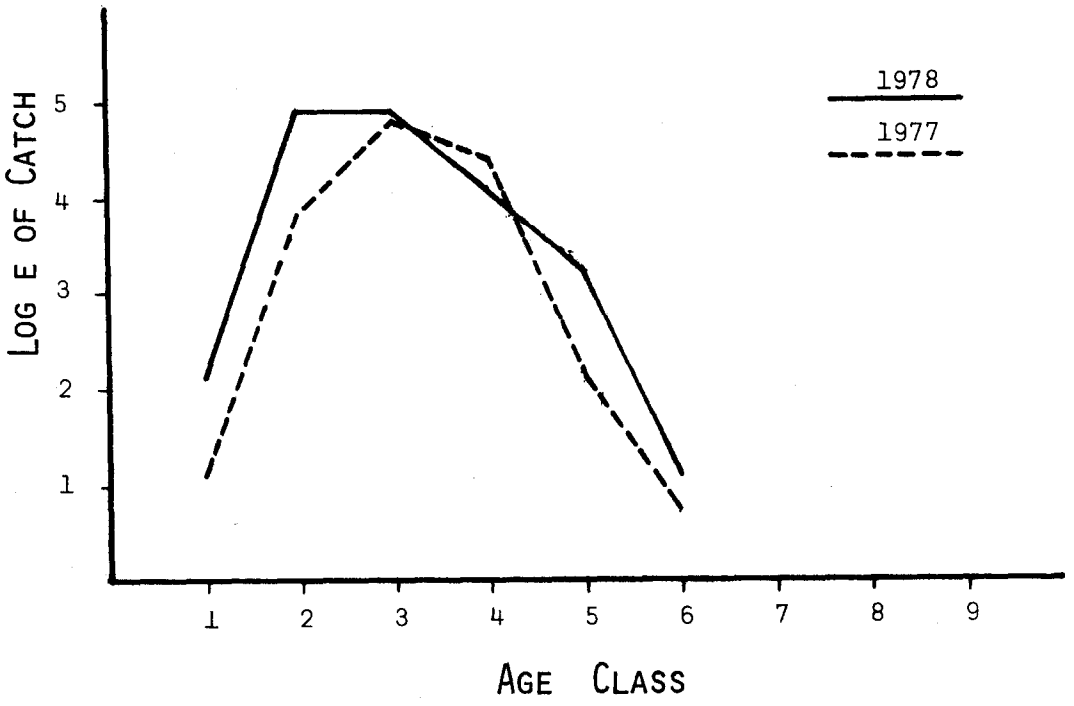
Figure 18. Estimation of the natural mortality coefficient (M) from effort and total mortality (Z) for rainbow trout from the South Fork Boise River below Anderson Ranch Dam, 1974 to 1978.

Table 18. Estimates of mortality and survival of rainbow trout sampled from angler creels during the general trout season, 1974-1978, South Fork Boise River.

		1978	1977	1976	1974
Mortality coefficient	Z	1.10	1.16	1.58	1.71
Survival rate	S	.33	.31	.21	.18
Total mortality rate	1-S	.67	.69	.79	.82
Natural mortality coef.	M	.48	.48	.48	.48
Fishing mortalify coef.	F	.62	.68	1.10	1.23
Fishing mortality rate	E	.38	.40	.55	.59
Natural mortality rate	,D	.29	.29	.24	.23
Effort expended for fish creeled (hrs)	-	1023	1131	1827	-

Table 19. Estimates of total mortality and survivability of mountain whitefish sampled from angler creels during the winter whitefish seasons, 1973-1978, South Fork Boise River.

	1977-78	1976-77	1973-74	Combined
Mortality coefficient, Z	1.18	.90	1.19	.95
Survival rate, S	.31	.41	.30	.39
Mortality rate, 1-S	.69	.59	.70	.61



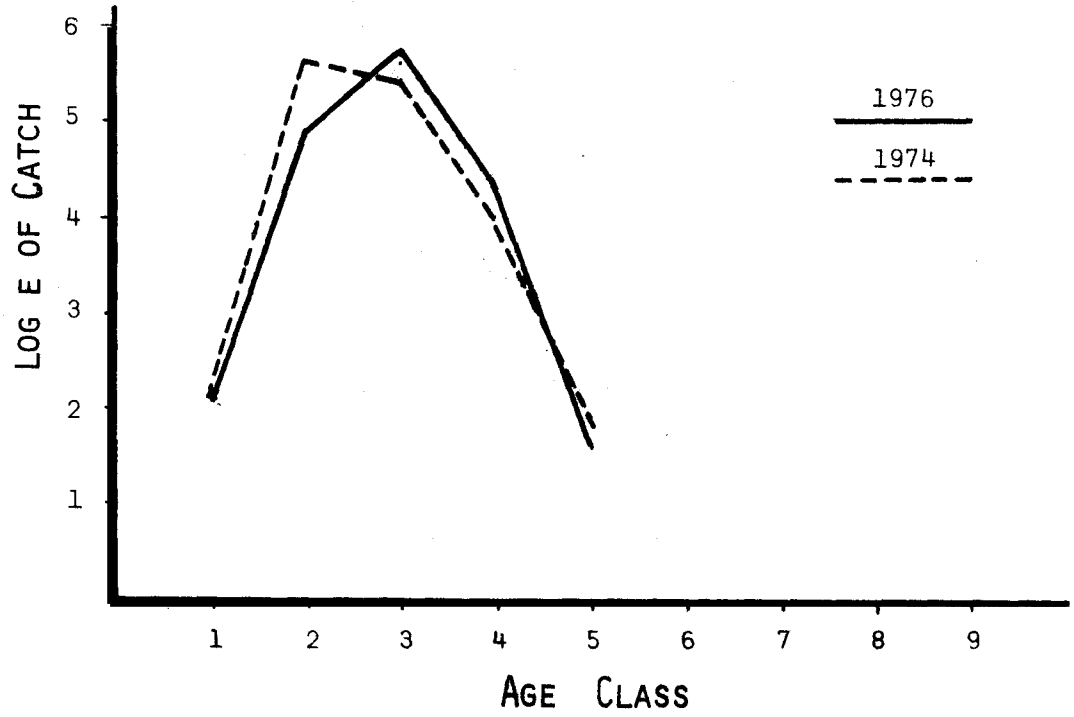


Figure 19. Catch curves for wild rainbow trout sampled by test angling for 1976-1978 and in the creels for 1974 from the South Fork Boise River. Ages 7, 8 and 9 were estimated from age-growth extrapolations.

Whitefish

Total mortality rates from age 5 to age 9 for whitefish, based on catch curves from the winter whitefish seasons, were 69% for 1977-78; 59% for 1976-77, and 70% for 1973-74 (Table 19). The age of recruitment to the fishery dropped from age 6 during 1973-74 to age 5 in 1976-77 and 1977-78, even though the mean size of fish in the creel (345 mm) has not changed (Fig. 20).

Natural mortality cannot be calculated at this time because of inadequate data. Fishing effort does not appear to be a significant factor in mortality of whitefish in the South Fork. This is supported by the lack of change in the mean length of whitefish over the years despite changes in angler effort.

DISCUSSION

The South Fork below Anderson Dam has responded well to implementation of restrictive fishing regulations and cessation of hatchery trout planting. It has developed into one of the highest quality wild rainbow trout streams in Idaho. It offers a quality angling experience, both in esthetics and high catch rates of rainbow trout and whitefish. Catch rates (1.64 fish/hr) and mean length for wild rainbow in the creel (372 mm, 14.6 in) substantially surpass those found at the famed Henrys Fork of the Snake River in 1976 (1.24 fish/hr and 263 mm) (Coon 1977). There is reason to expect that effort and harvest will increase each year as more anglers become aware of the fishing opportunity in the South Fork. To maintain and improve this fishery, the recruitment must be continually increased as fishing mortality increases or the harvest must remain at low levels. The success of the wild rainbow fishery depends directly on spawning success and a high quality environment. Several options are available which can help protect and perpetuate this fishery.

Maintaining the quality of the main river environment and habitat is of primary importance. A degraded aquatic habitat will not be conducive to production of a quality wild trout fishery regardless of the degree fishing is restricted by regulation.

The proposal for the re-regulating dam should be eliminated. The affected area presently supports the highest catch rates, largest trout and highest densities of trout caught per mile for the river sections studied. Loss of this 3.3-km (2.0 mi) section would reduce the amount of stream available to fishing by 18%. Fishing effort in adjacent areas would then increase and result in a decrease in the quality of the angling experience.

Minimum flows of 17 m^3/s (600 cfs) from 1 April to 31 August and 8,5 m^3/s (300 cfs) from 1 September to 31 March should be instituted. These flows will improve spawning success, decrease redd mortality, and increase rearing habitat by providing spawners access and use of the numerous side channels in the South Fork. Present river flow management does not provide optimum use of the side channels.

The area available to fishing in the South Fork is restricted and could easily suffer from increased use. Nothing should be done to encourage additional angler use such as improved road access and boat launching facilities. This may help slow the increase of angler use which is sure to occur. Providing foot travel access to the area below Danskin Bridge will increase the amount of river available to fishing. This should help absorb future increases in angler effort by

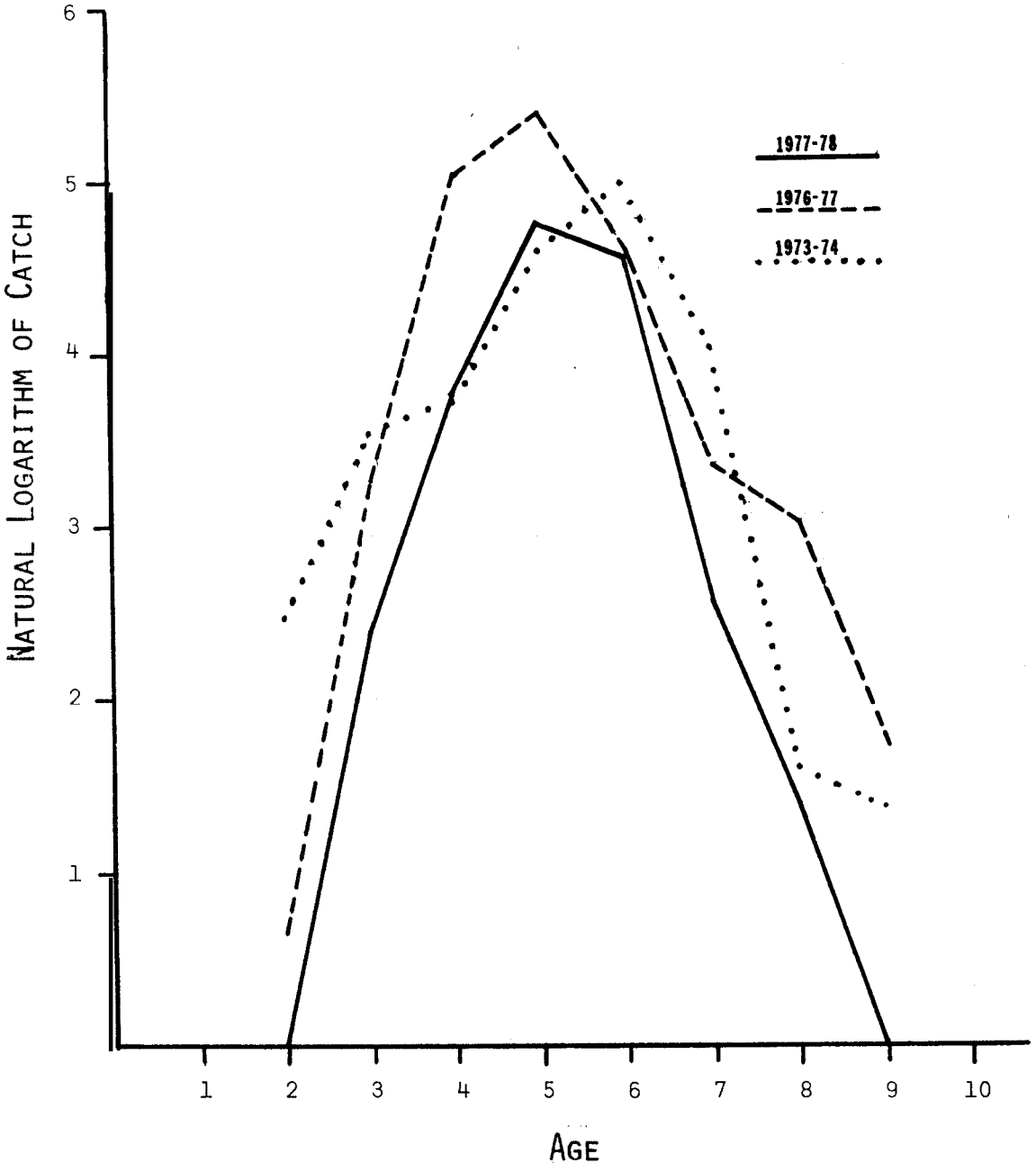


Figure 20. Catch curve for mountain whitefish from the South Fork Boise River, Anderson Ranch Dam to Danskin Bridge, 1973 - 1978.

providing an area not now used by the public and could contribute to maintaining the quality of the fishery.

The tributaries of the South Fork provide substantial spawning and rearing areas for main river rainbow. Protection of tributary streams and their riparian areas from grazing damage along with a stream improvement program (identified in this report) would allow maximum use of this available spawning and rearing habitat. Spreading the spawning activities of rainbow over a more diverse area will create better protection for the trout populations against catostrophic losses. Recruitment to the river from tributaries should also increase.

Present management goals of a self sustaining wild trout population in the South Fork are being met. Many changes are still occurring in the population due to the special trout regulations. These changes in addition to proposed changes in the management of flows at Anderson Ranch Dam and changes in angler use will require continued monitoring of the fishery to determine how it will respond. We suggest the creel census be continued to further document changes in angler use and rainbow trout size. Snorkel trend counts should be conducted annually in the established transects to obtain abundance trend information on rainbow trout.

If we find in the future that recruitment is not adequate to maintain the rainbow population at its present level, then future size restriction may be effective in providing more production to the South Fork system. With present regulations only rainbows 305 mm (12 in) total length or smaller are protected from harvest. The mean length of female spawners was 378 mm (14.9 in). Based on age and growth studies females spawners are subjected to harvest for at least one season before reaching spawning size. An increase in the minimum size regulation to approximately 355 to 380 mm (14 to 15 in) total length would protect most female rainbow through their first spawning. This should add more fry to the system.

The future of the South Fork fishery appears good, but the observation period has been relatively short and many changes are still proposed that may affect the aquatic environment.

LITERATURE CITED

Beach, D. R. 1975. Survey of fish harvest in the South Fork of the Boise River from Anderson Ranch Dam to Arrowrock Reservoir (Job III-3). Idaho Department of Fish and Game. p. 27

Bureau of Reclamation. 1977. Anderson Ranch Powerplant Third Unit, Formulation working document covering appraisal-grade work to date, November. BOR, Boise. p. 419

Chapman, D. W., S. Pettit and K. Ball. 1973. Evaluation of catch and release regulations in management of cutthroat trout. Annual Progress Report F-59-R-4. Idaho Department of Fish and Game. 18 pp.

Coon, J. 1977. Henrys Fork Fisheries Investigations, Project F-66-R-2, Job VII Idaho Department of Fish and Game. p. 23.

Jeppson, P. W. 1970. South Fork of the Snake River Investigations. Job 2-

Test for increasing the returns of hatchery trout. Job completion report, Project F-32-R-21, Vol. 25, No. 4B. p. 6-33.

Johnson, T. H., and T. C. Bjornn. 1975. Evaluation of angling regulations in management of cutthroat trout, Job Performance Report Project F-59-R-6. Idaho Department of Fish and Game.

Lackey, R. T. 1974. Introductory fisheries science, Seat Grant Extension Division, Virginia Poly Tech. Inst. and State University. Blacksburg. p. 275

Lagler, K. F. 1956. Freshwater fishery biology. Wm. C. Brown Co. Dubuque. p. 421.

Mate, S. M. 1977. South Fork Boise River fisheries investigations. Project F-M-R-2. Idaho Department of Fish and Game. p. 25

_____. 1978. South Fork of the Boise River creel census and fish population studies. Annual report to the U.S. Bureau of Reclamation. Project 6-01-01-18020, Idaho Department of Fish and Game. p. 19

Mate, S. M. and D. R. Cadwallader. 1978. South Fork of the Boise River creel census and fish population studies. Quarterly Report to the U.S. Bureau of Rec., 1 April to 30 June 1978. Project 08-07-10-5 0062, Idaho Department of Fish and Game, p. 13.

McAfee, W. R. 1966. Mountain whitefish. In A. Calhoun (ed.) Inland fisheries management. State of California, The Resources Agency, Pet. of Fish and Game. p. 299-303

Pettit, S. W. and R. L. Wallace. 1975, Age, growth and movement of mountain whitefish, Prosopium Williamsoni (Girard), in the North Fork Clearwater River, Idaho. Trans. Am, Fish, Sec, 104:68-76

Pollard, H. A. II. 1979. Review of hooking mortality literature. 1979 Fishery Conference, Idaho Department of Fish and Game, Boise, p. 7

Royce, W. F. 1972. Introduction to fishery sciences. Academic Press, New York p. 351.

Sigler, W. F. 1951. The life history and management of the mountain whitefish, Prosopium Williamsoni (Girard) in Logan River, Utah. Utah St. Coll. Agric. Exp. Sta., Bull;347. p. 21

Wade, D. T., White, R. **G.** and S. Mate. 1978. A study of fish and aquatic macroinvertebrate fauna in the South Fork Boise River below Anderson Ranch Dam. Annual Progress Report, 1 September 1976 to 30 September 1977. To Bureau of Reclamation contract no. 14-06-100-9220. College of Forestry Wildlife and Range Sciences, University of Idaho. p. 117.

APPENDIX

Appendix 1 - Distance to Reference Points for South Fork Boise River

Reference point	Mile	Kilometer
Mouth of South Fork	0	0
Camp Creek	7.2	11.6
Rattlesnake Creek	8.6	13.8
Chicken Creek (upper limit of Arrowrock Reservoir)	9.3	15.0
Neal Bridge	10.2	16.4
Big Fiddler Creek	11.7	18.8
Smith Creek	12.8	20.6
Little Fiddler Creek	14.8	23.8
Devil's Hole Creek	16.2	26.1
Timber Gulch Creek	18.9	30.4
Dead Horse Creek	21.1	33.9
Trail Creek	22.1	35.6
Rock Creek	23.5	37.8
Bock Creek	23.8	38.2
Mennecke Creek	25.2	40.5
Danskin Bridge	26.3	42.3
Pierce Creek	26.5	42.6
Granite Creek Camp Ground	27.6	44.4
Granite Creek	28.1	45.2
Cow Creek Bridge	29.9	48.1
Cow Creek	30.0	48.3
Rough Creek	30.8	49.6
Indian Rock	31.0	49.9
Dive Creek	32.8	52.8
Rec. Village	35.7	57.4
Anderson Bridge	35.9	57.8
USGS Gage	36.1	58.1
Anderson Ranch Dam	38.0	61.1

Appendix 2 - TRENDS IN FISHING STATISTICS

SOUTH FORK BOISE RIVER 1974-1978

General trout season	1974	1976	1977	1978
x̄ length of WRB from creel (<305 mm)	351	345	370	372
x̄ length of WRB from catch and release (<305 mm)	351	346	363	387
x̄ length of WRB from catch and release	281	301	326	298
WRB 305 mm catch and release	33%	48%	64%	44%
WRB 405 mm catch and release	2.1%	2.6%	8.7%	8.6%
WRB 405 mm creel	6.2%	5.5%	19.5%	26%
WRB 405 mm catch and release 305 mm	6.2%	5.5%	13.6%	19.6%
Catch rates RBT all fish-general trout season	0.64	0.74	0.97	1.64
RBT caught then released	10.6%	86.0%	90.7%	94.5%
Hours of effort	26,443	14;958	12,117	18,647
Catch (all RBT hooked)	19,272	11,076	11,818	30,579
Creeled (all RBT killed)	17,542	1,551	1,103	1,677
Catch (WRB hooked)	7,440	10,850	11,818	30,579
Creeled (WRB killed)	5,710	1,325	1,103	1,677

Whitefish season (1 Dec.-28 Feb.)	1973-74	1976-77	1977-78
x̄ length creel	345	345	346
Catch rate	1.24	2.50	1.54
Hours of effort	2,471	4,249	3,710
Catch	3,063	10,462	5,727
RBT hooked	60	713	675
RBT catch rate	0.024	0.066	0.11

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