MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

JOB COMPLETION REPORT
RESEARCH PROJECT SEGMENT

State of Montana

Project No. F-32-R-2 Name Helicopter Mountain Lake Survey

Job No. I Title Mountain Lake Survey - Sun and Teton River Drainages

Period Covered: July 1, 1965 to June 30, 1966

Abstract:

In July 1965, fifteen high mountain lakes were surveyed in District Four. Personnel and gear were transported by helicopter. Work maps of each lake were prepared. Gill net results indicated that Lake Levale and Bear Lake were the only lakes with good trout populations. Both lakes contained Yellowstone cutthroat trout and it appeared that natural reproduction is adequate to support the present fishery.

It is recommended that six of the lakes surveyed be added to the fish planting schedule. The remaining lakes were too shallow to sustain trout populations.

Recommendations:

Yellowstone cutthroat trout should be planted in Renshaw Lake and Our Lake in 1966. Future plants of this species could be made in Sock Lake, Three Lakes I and II, and North Fork of Lick Creek Lake.

Techniques Used:

Depths were taken with a Bendix DR-21 depth recorder and fish populations were sampled with 125-foot nylon experimental gill nets. A helicopter was used for transportation to and from the lakes.

A work map was drawn of each lake showing the depth, shoreline and any inlets or outlets. The name of the lake, township, range, section number, date surveyed, and the direction of North were entered on the map.

Fish were measured to the nearest tenth of an inch, (total length) and weighed to a hundredth of a pound. Work maps and other data are filed in the District Four Fisheries Office in Great Falls.

Findings:

Fifteen high mountain lakes (approximately 7,000 feet in elevation) were surveyed in July 1965 (Table 1).

In Lake Levale, one gill net was set for two days and caught 36 Yellowstone cutthroat trout. These fish averaged 10.1 inches in length and .36 pounds in weight. The maximum recorded depth in Lake Levale was 37 feet. In Bear Lake, one gill net was set overnight and caught 6 Yellowstone cutthroat trout. These fish averaged 13.5 inches in length and .76 pounds in weight. The maximum depth recorded in Bear Lake was 45 feet. Both Lake Levale and Bear Lake trout reproduce sufficiently to withstand present fishing pressure.

No fish were taken in the other lakes surveyed. Six lakes were considered deep enough to over-winter fish and provide some fishing if planted; these were: Renshaw Lake, maximum depth 25 feet; Our Lake, maximum depth 58 feet; Sock Lake, maximum depth 24 feet; Three Lakes I and II, maximum depth 14 feet in each; and North Fork of Lick Creek Lake, maximum depth 17 feet. Trout are known to have survived in the past in Renshaw Lake and Our Lake.

The suggested management plan is to plant Yellowstone cutthroat trout in Renshaw Lake and Our Lake in 1966. It is recommended Sock Lake, Three Lakes I and II, and the North Fork of Lick Creek Lake be stocked with Yellowstone cutthroat trout sometime in the future. Other lakes surveyed were considered to be too shallow to sustain a trout population.

Table 1. Mountain Lakes Surveyed in July 1965.

Name and Code No.	Species of trout caught	Future trout management
Renshaw Lake 20-8000-3	None	Plant Yellowstone cutthroat in 1966
Lake Levale 20-7650-3	Yellowstone cutthroat	Present fishing pressure taken care of by natural reproduction
Bear Lake 20-6950-3	Yellowstone cutthroat	Present fishing pressure taken care of by natural reproduction
Our Lake 14-8440-3	None	Plant Yellowstone cutthroat in 1966
Sock Lake 20-8150-3	None	Possible planting in future
Three Lakes No. 1 20-8320-3	None	Possible planting in future
Three Lakes No. 2 20-8321-3	None	Possible planting in future
Three Lakes No. 3 20-8322-3	None	Too shallow
My Lake 20-7890-3	None	Too shallow
North Fork of Lick Creek Lake 20-7930-3	None	Possible planting in future
Prairie Creek Lake 20-7965-3	None	Too shallow
Baldy Bear Creek Lakes 1 and 2 20-6875-3	None	Too shallow
Unnamed Lake 20-8450-	None	Too shallow
Lake Quiet 20-7990-3	None	Too shallow

Prepared by: Richard Johnson Approved by: George D. Holton

Date: July 11, 1966

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

JOB COMPLETION REPORT
RESEARCH PROJECT SEGMENT

State of Montana

Project No. F-5-R-15 Name Central Montana Fisheries Study

Job No. I Title Inventory of Waters of the Project Area

Period Covered: July 1, 1965 - June 30 1966

Abstract:

On opening dates at Bean Lake, August 23, 1964, and May 23, 1965, boat fishermen caught more fish than shore fishermen. On the 1964 opening boat and shore fishermen (combined) caught 5.0 rainbow trout per man at 1.3 fish per hour. On the 1965 opening the total catch was 2.0 rainbow trout per man at .50 fish per hour. Between July 9, 1963, and June 30, 1966, 523 jaw tags were returned by fishermen who had fished in the Tiber Reservoir-Marias River area. This is 5.4 per cent of 9,636 tags placed on catchable rainbow trout planted in July, 1963. Forty-eight per cent of the tag returns came from people living within 50 miles of Tiber Reservoir; 26 per cent from within 100 miles and 26 per cent from over 100 miles. Eighteen rainbow trout gill netted March 1966 in Durand Reservoir averaged 11.8 inches and .62 pounds. Four cutthroat trout gill netted in Forest Lake June 17, 1966, averaged 16.8 inches and 1.83 pounds.

Recommendations:

It is recommended that marked sub-catchable rainbow trout be planted in Bean Lake. Increase the size of the plant to see what effect this would have on growth and catch-per-hour.

The fishery in Tiber Reservoir could be enhanced and popularity increased by more intensive management. The introduction of northern pike or walleye could produce a desirable low-cost fishery.

Durand (Harris) Reservoir is an irrigation impoundment and is drawn down to an extremely low level each year. Management is limited to stocking. Rainbow trout planted as sub-catchables have produced a good fishery.

Additional gill netting in Forest Lake is desirable to find out the population structure of cutthroat trout.

Objectives:

The purpose of this investigation is to determine the physical, chemical and biological characteristics of the waters of highest importance to the recreational fisheries of the project area.

Techniques Used:

Opening day creel census was performed by Department personnel at Bean Lake. Creel census in the Tiber Reservoir-Marias River area was conducted by a fisheries student assigned full time during the summer of 1963. Plastic jaw tags were placed on hatchery reared rainbow trout released in the Willow Creek Arm of Tiber Reservoir in July 1963. The fish averaged 10 inches in length at the time of planting. Tags were collected by the creel census taker in 1963 and there were voluntary returns by fishermen after the creel census terminated. Fish were collected in Durand (Harris) Reservoir and Forest Lake with 125-foot experimental gill nets. Fish were measured to the nearest tenth of an inch (total length) and weighed to a hundredth of a pound.

Findings:

Bean Lake is approximately 15 miles south of Augusta in Lewis and Clark County. It is a natural lake with 200 surface acres. On February 6, 1964, 15-17 acres of access were acquired by the Montana Fish and Game Department. The completion report for Montana D-J Project F-5-R-13, Job 1, (1964) describes fish population information obtained from Bean Lake by gill-netting. After many years of no stocking, Bean Lake was stocked in April 1964 with 37,500 (graded rainbow trout averaging 9.6 inches and .35 pounds. Ten thousand five hundred brook trout averaging 7.7 inches and .19 pounds were planted through the ice in January 1965. A third plant consisted of 21,312 rainbow trout planted in June 1965. Each had the left ventral fin clipped, and they averaged 4.5 inches and .19 pounds.

Bean Lake was closed to fishing on February 15, 1964. A gill net set August 20, 1964, caught 26 rainbow trout averaging 13 inches and .87 pounds. Two white suckers and 1 longnose sucker were taken at this time and were over 14 inches in length. The lake was opened to fishing August 23, 1964. Creek census data is presented in Table 1.

Table 1. Opening day creel census - Bean Lake, August 23, 1964.

	Parties	Fishermen	Man Hours	Fish	Catch/man	Catch/hour
Boat	145	348	1,289	2,474	7.1	1.9
Shore	86	185	730	205	1.1	.3
Total	231	533	2,109	2,697	5.1	1.3

On August 23 boat fishermen caught fish at a faster rate than shore fishermen. The overall catch per man was 5.1 and the catch per hour 1.3.

Bean Lake was closed to fishing at the end of the regular fishing season November 30, 1964, and was reopened with the start of the fishing season May 23, 1965. Creek census on opening day May 23, 1965, is given in Table 2.

Table 2. Opening day creel census - Bean Lake, May 23, 1965.

	Parties	Fishermen	Man Hours	Fish	Catch/man	Catch/hour
Boat	75	181	790	467	2.6	.6
Shore	28	64	213	30	.5	.1
Total	103	245	1,003	497	2.0	.5

On May 23, 1965 boat fishermen again caught fish at a faster rate than shore fishermen. The overall catch per man was 2.0 and the catch per hour .5. Heavy rainfall and wind probably influenced fishing on this date. Brook trout planted in 1965 were not censused in the catch on May 23, 1965. Bean Lakes' fishing season was continued through the regular fishing season which closed November 30, 1965. Starting December 1, 1965 Bean Lake was opened to fishing throughout the year.

Gill net results from Bean Lake show that 26 rainbow trout planted in 1964 grew 4.8 inches and .83 pounds in 13 months. Thirteen brook trout planted in 1965 grew 4.4 inches and .58 pounds in 17 months. Seven marked rainbow trout planted in June 1965 and gill netted September 3, 1965 averaged 9.0 inches and .31 pounds. Forty-two marked rainbow trout planted in 1965 grew 7.9 inches and .61 pounds in 12 months.

In July 1963 a study on the feasibility of management with catchable rainbow trout was initiated in the Tiber Reservoir-Marias River area. Plastic jaw tags were placed on 9,636 rainbow trout. The trout averaged 10 inches in length and were released in the Willow Creek Arm of Tiber Reservoir. Creel census was conducted by a fisheries student during the summer of 1963; after that, tags would be returned on a voluntary basis.

From July 9, 1963, to June 30, 1966, 523 tags, or 5.4 per cent were returned. Tag returns were returned from the following areas: Not specified--160 tags (30.6 per cent), above Tiber Dam--107 tags (20.5 per cent), and below Tiber Dam--256 tags (48.9 per cent). Tags have been returned by 115 fishermen, and of this number better than 4 per cent came from people residing out of state. Tags have been sent from 35 cities and towns located in the U.S.A. and Canada. Forty-eight per cent of the tag returns came from people living within 50 miles of Tiber Reservoir; 26 per cent from within 100 miles, and 26 per cent from over 100 miles. Lately (summer 1966), fishermen have reported tagged trout weighing between 1½ to 3 pounds and 13 to 21 inches in length. Two plants of rainbow trout are made annually in the Marias River between Tiber Dam and Sanford Park; these plants are effective and should continue.

Durand (Harris) Reservoir, located in Meagher County, was gill netted in March 1966. Two experimental gill nets set for a total of 46 hours caught 18 rainbow trout; they averaged 11.8 inches and .62 pounds. Two brook trout averaged 10.8 inches and .57 pounds.

Forest Lake, located near Lennep, Meagher County, was rehabilitated in August 1956. About 200 cutthroat trout were transplanted from Boundary Lake in 1959. A gill net set for 2½ hours on June 17, 1966, took four trout which averaged 16.8 inches and 1.83 pounds.

Fish populations in several other waters were sampled with electric shocker and gill nets during the report period. The data obtained have been recorded in the District stream and lake survey file.

Prepared by Steve E. Swedberg Approved by George D Holton

Dated July 20, 1966

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

JOB COMPLETION REPORT
RESEARCH PROJECT SEGMENT

State of Montana

Project No. F-5-R-15 & 16 Name Central Montana Fisheries Study

Job No. II Title Evaluation of Fish Habitat Destruction in Little Prickly Pear Creek due to Construction of Interstate Highway 15

Period Covered: July 1, 1965 to June 30, 1966 and July 1, 1966 to June 30, 1967

ABSTRACT:

Post-construction measurements of trout habitat characteristics were completed and compared to preconstruction data. Channel realignment shortened the stream from 10.95 miles to 9.66 miles. Prior to construction about 2.5 stream miles were altered. After construction about 6.2 stream miles were altered. Construction increased average stream width and depth 7.1 feet and 3.1 inches respectively. Numbers and pounds of trout per acre were low during construction years in Shocking Sections 2 and 6. Jetty-formed-pools in Shocking Section 3 provided better trout habitat than existed previously. Construction appeared to affect rainbow trout less than brown trout. During 1949-51 and 1961-66 trout made up 74.6 to 94.7 per cent of the fish population by number and 31.1 to 81.2 per cent by weight. Suckers and whitefish were thought to be migratory.

RECOMMENDATIONS:

Make an annual fish population inventory, using mark and recapture technique, in Section 3 (altered with jetties but no overhead cover) and in Section 6 (relatively unaltered with natural habitat). Establish a new section between Shocking Sections 2 and 3 (altered without jetties but with light bank cover) and include it in the annual population inventory. Expand each section to 1,000 feet to obtain larger sample sizes of fish. See if larger sizes of trout remain in the jetty-formed pools in Section 3. See what sizes of trout are in the new section, and if this type of habitat can hold large trout.

OBJECTIVES:

The purpose of this investigation is to determine the extent of trout habitat destruction caused by construction of Interstate Highway 15 along Little Prickly Pear Creek and obtain information on the effect of highway construction on fish and aquatic insect populations.

TECHNIQUES USED:

Pre- and post-construction measurements were measured in 100-foot sections. Measurements began at the railroad bridge located about one-half stream miles below fish Shocking Section 6, Figure 1. Measurements terminated about 200 feet below Turtle Rock located about one-half stream miles below the town of Wolf Creek.

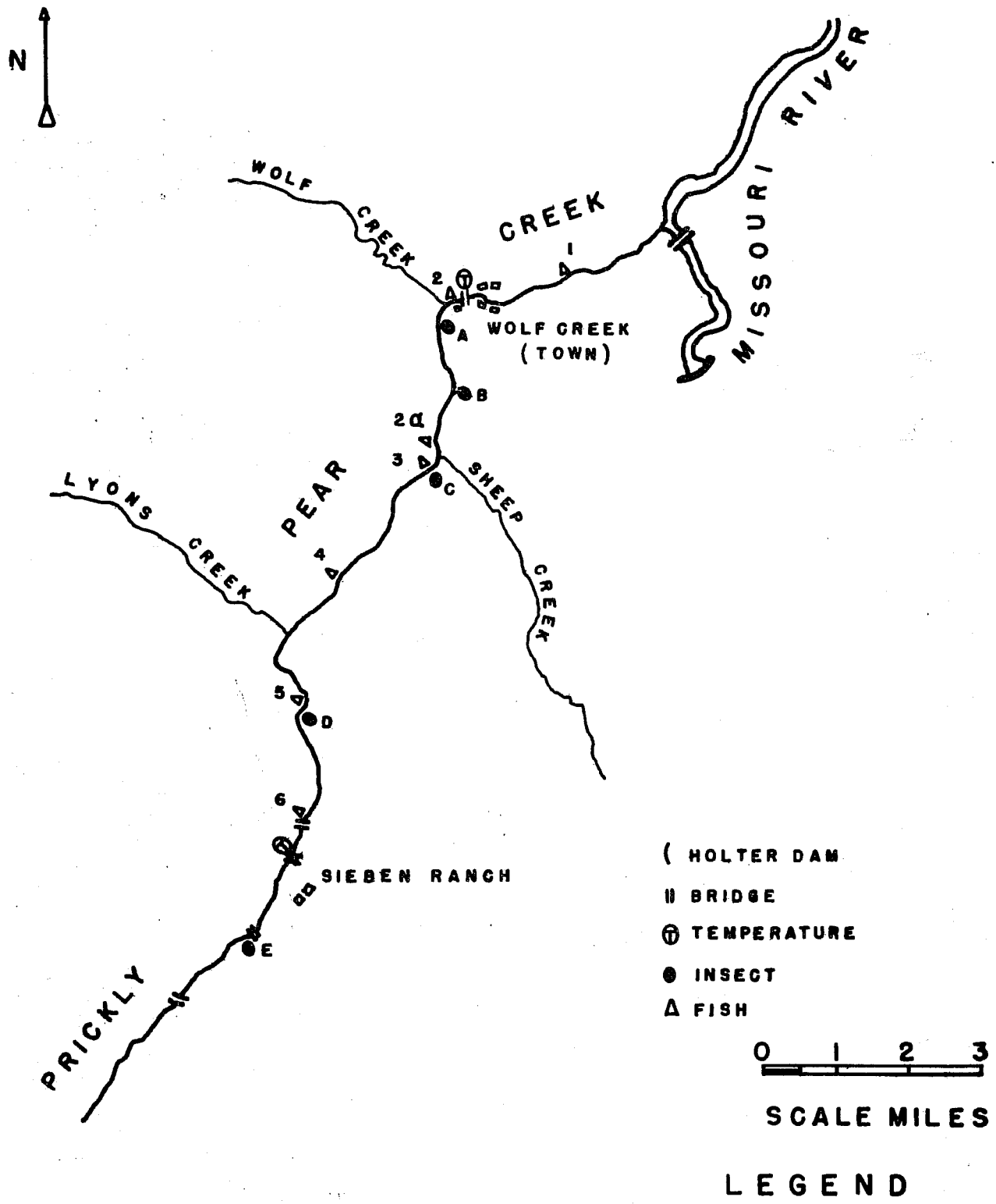
Measurements of trout habitat characteristics consisted of obtaining the following stream data: Average width was based on three measurements equally spaced in each 100 feet of stream. Three depths were measured across the stream each time the width was measured as a basis for average depth. Linear measurements were divided into average length of pools, runs and riffles. Pools were classified according to their number, size and type. Shade cover above the surface of the water was classified by number and type. Stream alterations consisting of riprip and diking were measured in feet and converted to miles.

Temperatures were recorded with two Taylor thermometers in July, August and September in 1965; one was located at Sieben Ranch and the other at Wolf Creek, Figure 1. The recorders plotted water temperatures for 7 day periods.

Bottom fauna were collected with a Surber sampler having a 1-square foot frame. Three 4-square foot samples were taken at each of 5 stations, Figure 1. Organisms were identified to order.

Fish were generally collected at Sections 2, 3, 4, 5 and 6 with either a 110-220 volt alternating-current generator or a 110-220 volt direct-current generator. Each section was approximately 600 feet in length, except in 1966 when Sections 3, 4, 5 and 6 were 550, 853, 728 and 690 feet respectively. Block nets were placed at each end of a section just prior to shocking. Three passes were made with the electrodes when shocking a section. MS-222 was used to anesthetize fish. Fish were weighed to the nearest 0.01 pound and measured in total length to the closest 0.1 inch. Cottus species were abundant but were not accounted for. Scale samples were taken and read in 1965. Scales were mounted on acetate strips and read with the aid of a projection machine. A nomograph was used to determine growth of fish.

Data for 1949-51 and 1961-66 were taken from District files and incorporated in this report.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SCALE MILES
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Figure 1. Map

FINDINGS:

Stream Measurements

Preconstruction measurements began July 11, 1962 and were completed September 12, 1963. Post-construction survey began October 8, 1964 and was completed August 25, 1966. Results of the two surveys are compared in Table 1.

Previous to construction of Interstate Highway 15 much of the stream in Wolf Creek Canyon was bordered by State Highway 91 and the Great Northern Railroad. Interstate Highway Channel realignment shortened the stream from 10.95 miles to 9.66 miles. Alterations consisted of riprap and diking. Prior to construction about 2.5 stream miles were altered. After construction about 6.2 stream miles were altered. Construction increased average stream width and depth 7.1 feet and 3.1 inches respectively. The average increase in stream depth was attributed to the installation of jetties and check dams by the State Highway Department.

Additional stream measurements not described in Table 1 were of pool size and are given below:

(1) Pools having an average width or length much greater than the width of the stream; there were 38 pools before and 15 pools after construction.
(2) Pools having a width or length equal to the width of the stream; there were 96 pools before and 77 pools after construction.
(3) Pools much narrower or shorter than stream width; there were 207 pools before and 131 pools after construction.

Preconstruction measurements showed approximately 96.9 per cent of 578 stream sections contained shade cover above the surface of the water. Post-construction measurements showed 29.2 per cent of 510 stream sections contained shade cover above the surface of the water.

Sedimentation

In May 1962 the U. S. Geological Survey began a study of sediment discharge, Gustafson (1967). They found that streamflow during May to September 1962 and during 1963-65 was fairly stable, except during May and June when much of the sediment was discharged during high water. In August 1963 the U. S. Geological Survey began an aggradation-degradation study of a relocated channel. They made a second survey of the area in September 1966 and found that most of 7 jetties, which had been installed by the State Highway Department, had washed out. Material resulting from scour in the upper part of the study area had been deposited throughout a jetty-formed-pool 525 feet in length. The deposition consisted of very coarse gravel at the head of the pool and fine silt at the bottom. A gravel bar was built up near the head of the pool. Channel degradation occurred below the pool.

Table 1. Measurement of trout habitat characteristics on Little Prickly Pear Creek, Lewis and Clark County, Montana, 1962-1966.

	Before construction	After construction	Difference
Miles measured	10.95	9.66	- 1.29
Average width (feet)	31.5	38.6	7.1
Average depth (inches)	11.7	14.8	3.1
Number of pools	341	223	- 118
Average length of pools (feet)	37.8	42.5	4.7
Length of pools (total miles)	2.439	1.794	- .645
Percent of miles measured	22.3	18.6	- 3.7
Number of runs	409	309	- 100
Average length of runs (feet)	49.0	61.4	12.4
Length of runs (total miles)	3.794	3.591	- .203
Percent of miles measured	34.7	37.2	2.5
Number of riffles	451	353	- 98
Average length of riffles (feet)	55.2	63.8	8.6
Length of riffles (total miles)	4.713	4.270	- .443
Percent of miles measured	43.0	44.2	1.2
Pools: (Type) a/			
Number: (1)	85	22	- 63
(2)	147	42	- 105
(3)	109	159	50
Shade cover above surface of water: (Type) b/			
Number: (1)	24	6	- 18
(2)	245	58	- 187
(3)	291	85	- 206
(4)	18	361	343
Riprapping and diking: (miles)	2.531	6.207	3.676
(feet)	13,365	32,773	19,408

a/ Type of pools, 1, 2, 3, in parenthesis, were graded as:

(1)-Good-Deep (2 feet or more), exposed pools containing an abundance of aquatic plants harbouring a rich fauna; or deep pools with abundant shelter (overhanging banks, logs, roots, large boulders) much drift or detritus, shaded by forest canopy or shrubs.
(2)-Fair-Pools intermediate in depth, shelter, plant abundance, etc.
(3)-Poor-Shallow exposed pools without shelter and without plants; scouring basins.

b/ Shade cover above surface of water, 1, 2, 3, 4, in parenthesis, were evaluated as:

(1)-Dense-Over-hanging brush and trees.
(2)-Medium-Partly shaded if approximately half of the water is shaded.
(3)-Light-Some shade--small clumps of bushes, logs, etc., overhanging at waters edge.
(4)-No cover.

Temperature

Water temperatures were recorded during the months of July, August and September from 1962-64, Swedberg (1964), Swedberg and Nevala (1964 and 1965). Figures 2 and 3 contain data for 1965. Water temperatures during construction were not considered to be detrimental to the fish population.

Bottom Fauna

Bottom fauna were collected in September 1961 and in June, or July and September 1962-64, Swedberg (1964) and Swedberg and Nevala (1964-1965). Samples for 1965 are listed in Table 2. Tables 3 and 4 contain collections from 1961-65. Fluctuations in the bottom fauna could not be related to highway construction activities. Warner and Porter (1960) investigated a bulldozed trout stream in Maine. They noted the aquatic insect population was temporarily destroyed but recovered rapidly.

Shocking Sections

Six sections were set up in 1949 and shocked in 1949 and 1950, Stetanich (1952). Bishop (1955) studied the same sections in 1951. Sections 2, 3, 4, 5 and 6 were shocked in 1961-66 (Section 5 was not sampled in 1963 due to an influx of turbid water, resulting from construction upstream).

A very low water level in 1961 increased shocking efficiency and retrieval of fish.

Section 2:

Section 2 is at the mouth of Wolf Creek, Figure 1. Highway construction began in 1964 and was completed by mid-1965. Pre-construction survey was performed September 10, 1963 and post-construction survey August 23, 1966. The final survey showed an average gain in stream width of 13.5 feet with an average decrease in depth of 0.5 inches. Before construction there were three pools, (one good pool and two fair pools) six runs and three riffles. Total length of the pools, runs and riffles were 134, 334 and 132 feet respectively. After construction there was one fair pool, one run and five riffles. (The pool was reclassified from a poor pool to a fair pool because it had depth). Total length of the pool, run and riffles were 34, 66 and 500 feet respectively.

Before construction shade cover above the surface of the water was: dense (200-foot); medium (300-foot) and light (100-foot). The post-survey showed no shade cover above the surface of the water. Both streambanks are riprapped and in almost straight alignment.

Rainbow and brown trout samples for 1949-51 and 1961-66 are presented in Figure 4. Numbers of rainbow trout 7 inches and over were low in 1964 when 13 were taken. Numbers of brown trout

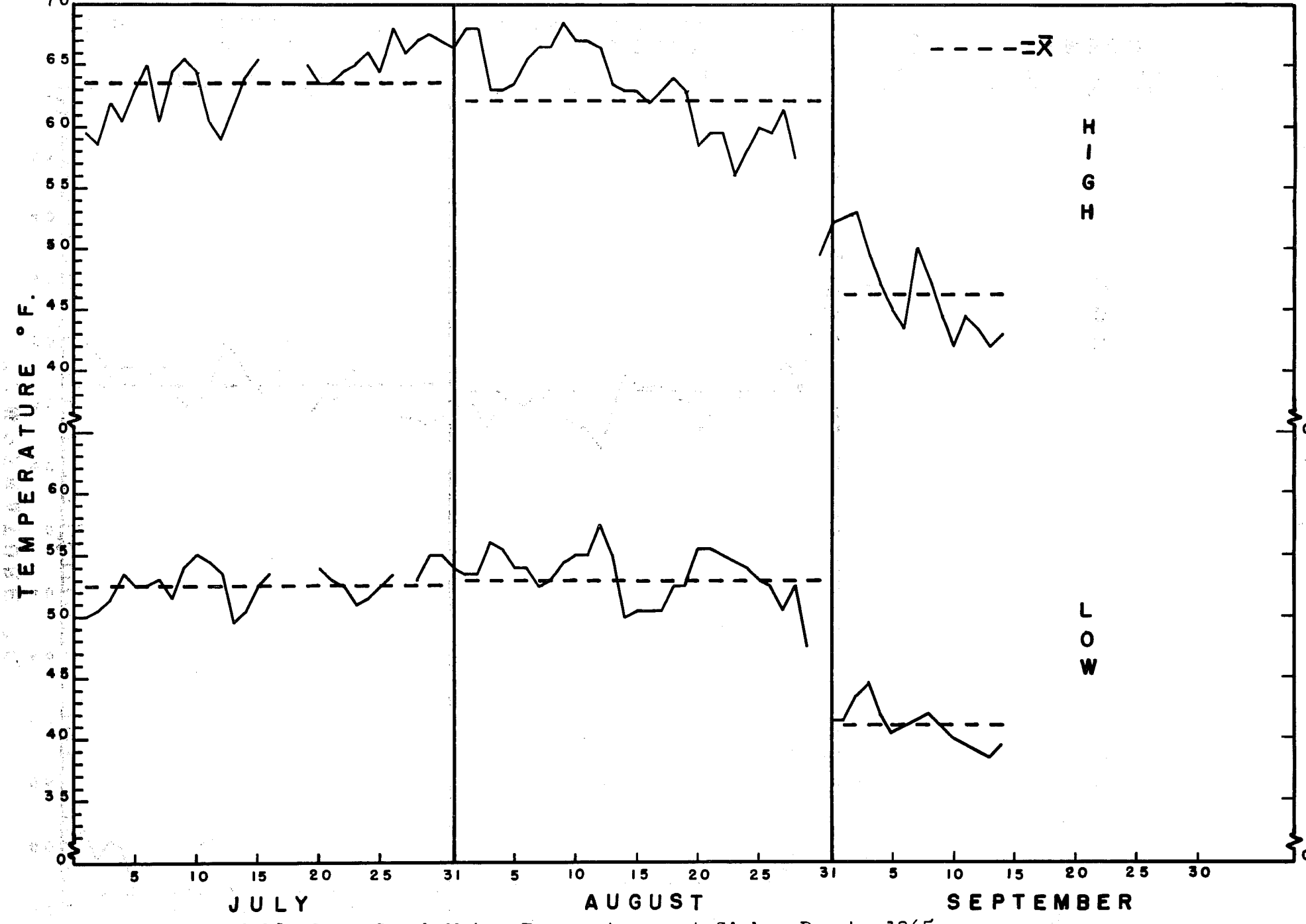

Figure 2. Prickly Pear Creek Water Temperatures at Sieben Ranch, 1965

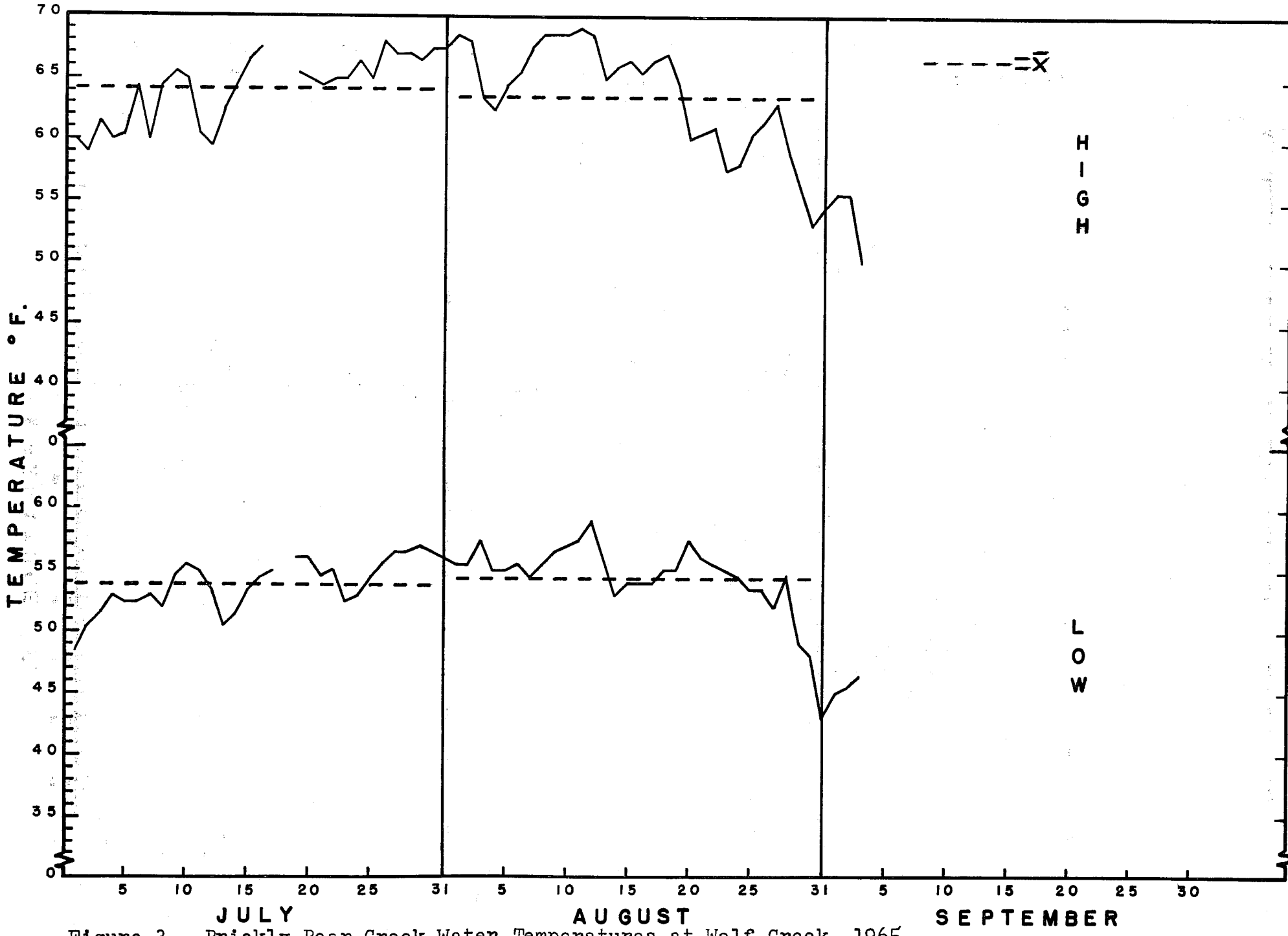

Figure 3. Prickly Pear Creek Water Temperatures at Wolf Creek, 1965.

Table 2. Summarization of bottom fauna samples collected in 1965 in Little Prickly Pear Creek, Montana.

Station	Date	Average number of organisms per square foot							
		Ephemeroptera	Plecoptera	Trichoptera	Coleoptera	Diptera	Oligochaeta	Gastropoda	Total Numbers
I	7/12/65	53.7	70.8	31.7	4.8	71.5	.2	-.-	232.7
I	9/29/65	29.5	2.4	.6	.6	68.0	-.-	-.-	101.1
II	7/12/65	56.7	35.0	10.4	3.1	96.1	1.7	.3	203.3
II	9/29/65	36.1	10.0	9.2	4.2	161.2	.4	5.4	226.5
III	7/ 9/65	23.0	49.5	36.1	8.1	151.3	.4	-.-	268.4
III	9/29/65	20.1	3.0	31.1	8.0	146.6	.2	2.5	211.5
IV	7/ 9/65	74.4	25.6	83.0	17.7	62.2	2.6	-.-	265.5
IV	9/29/65	12.0	2.8	16.2	7.6	60.5	-.-	-.-	99.1
V	7/ 9/65	25.6	11.1	94.1	18.6	40.2	15.4	-.-	205.0
V	9/29/65	15.0	7.0	129.1	9.2	11.4	2.2	-.-	173.9

Table 3. Summarization of bottom fauna samples collected in Little Prickly Pear Creek, Montana, 1962-1965.

Station	Date	Average number of organisms per square foot							
		Ephemeroptera	Plecoptera	Trichoptera	Coleoptera	Diptera	Oligochaeta	Gastropoda	Total Numbers
I	6/27/62	23.9	2.4	44.7	15.7	3.0	.1	.6	90.4
	7/ 1/63	27.5	1.5	37.3	11.0	3.8	1.2	-.-	82.2
	6/28/64	5.7	1.1	1.8	1.1	1.9	.2	.1	11.9
	7/12/65	53.7	70.8	31.7	4.8	71.5	.2	-.-	232.7
II	6/27/62	9.3	1.7	9.8	6.5	7.8	.1	.1	35.3
	7/ 1/63	36.2	2.3	25.9	7.4	3.8	.5	-.-	76.0
	6/28/64	16.4	1.7	2.8	1.0	1.5	.1	-.-	23.5
	7/12/65	56.7	35.0	10.4	3.1	96.1	1.7	.3	203.3
III	6/28/62	11.3	1.0	28.2	5.4	18.5	.1	.5	65.0
	6/28/63	23.2	1.5	38.3	6.8	5.9	.3	.2	79.2
	6/28/64	17.7	1.6	2.4	2.0	.7	-.-	-.-	24.5
	7/ 9/65	23.0	49.5	36.1	8.1	151.3	.4	-.-	268.4
IV	6/28/62	38.4	4.8	21.1	6.4	3.7	.1	-.-	74.5
	6/28/63	13.0	.6	6.6	7.2	4.3	.8	-.-	32.4
	6/28/64	23.1	2.2	14.2	2.7	3.2	.6	-.-	45.9
	7/ 9/65	74.4	25.6	83.0	17.7	62.2	2.6	-.-	265.5
V	6/28/62	49.8	2.5	32.1	10.3	8.0	.2	.1	103.0
	6/27/63	41.4	1.3	43.6	16.2	7.5	.5	.6	111.0
	6/27/64	46.4	2.0	42.7	65.7	2.4	.3	-.-	159.7
	7/ 9/65	25.6	11.1	94.1	18.6	40.2	15.4	-.-	205.0

Table 4. Summarization of bottom fauna samples collected in Little Prickly Pear Creek, Montana, 1961-1965.

Station	Date	Average number of organisms per square foot							
		Ephemeroptera	Plecoptera	Trichoptera	Coleoptera	Diptera	Oligochaeta	Gastropoda	Total Numbers
I	9/14/61	3.6	6.3	69.9	17.0	10.3	.2	4.2	111.6
	9/14/62	9.0	2.5	42.3	2.5	9.8	-	.1	66.2
	9/18/63	15.6	4.0	241.4	22.8	3.2	.5	5.4	292.9
	9/24/64	107.0	4.0	38.6	25.3	139.7	.1	.1	314.8
	9/29/65	29.5	2.4	.6	.6	68.0	-	-	101.1
II	9/14/61	7.6	15.9	135.8	41.7	24.6	2.9	2.7	231.2
	9/14/62	34.9	5.3	63.8	14.7	31.3	.6	.4	151.0
	9/19/63	9.6	1.6	172.1	26.3	2.0	-	9.6	222.8
	9/24/64	91.4	-	3.8	.3	12.0	-	-	107.5
	9/29/65	36.1	10.0	9.2	4.2	161.2	.4	5.4	226.5
III	9/14/61	4.6	6.8	65.3	110.8	4.9	.3	2.9	195.5
	9/13/62	14.0	5.3	53.1	8.2	27.3	-	.7	108.6
	9/19/63	9.6	1.0	34.7	14.2	6.9	.1	7.0	75.8
	9/24/64	63.4	1.5	8.6	2.4	44.3	-	.3	120.2
	9/29/65	20.1	3.0	31.1	8.0	146.6	.2	2.5	211.5
IV	9/15/61	5.7	8.3	127.3	135.4	4.2	1.0	59.3	341.1
	9/13/62	10.8	5.1	65.0	23.3	6.8	-	4.7	115.7
	9/18/63	25.8	4.7	55.1	21.1	.3	.1	.2	107.2
	9/24/64	32.2	3.9	49.1	17.0	4.8	-	.3	107.3
	9/29/65	12.0	2.8	16.2	7.6	60.5	-	-	99.1
V	9/15/61	16.7	19.0	439.8	85.4	33.2	.3	70.0	664.3
	9/21/62	17.6	6.8	29.7	24.0	58.9	.1	.8	137.9
	9/18/63	34.6	12.2	306.8	33.7	8.8	.8	16.8	413.7
	9/24/64	55.3	20.3	544.8	147.0	74.2	2.3	.6	844.4
	9/29/65	15.0	7.0	129.1	9.2	11.4	2.2	-	173.9

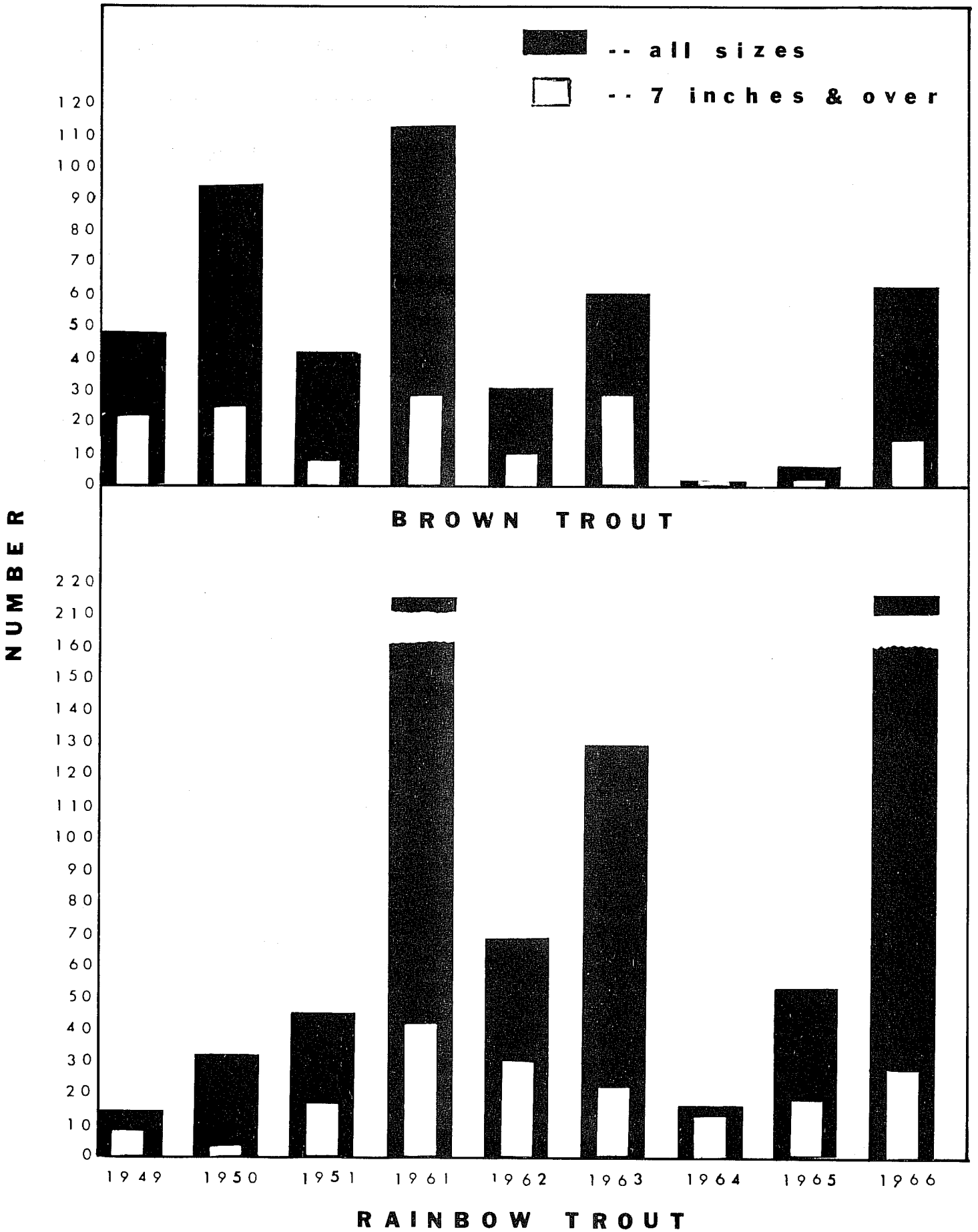
-- all sizes
-- 7 inches & over
NUMBER
120
110
100
90
80
70
60
50
40
30
20
10
0
BROWN TROUT
220
210
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1949
1950
1951
1961
1962
1963
1964
1965
1966
RAINBOW TROUT

Figure 4.

7 inches and over were lowest in 1964 and 1965, with one and two trout taken respectively.

Pounds of trout per acre for 1949-51 and 1961-66 are given in Figure 5. Collections in 1964 and 1965 (construction years) were about 10 and 13 pounds respectively; the two lowest figures in 9 years of sampling. However, in 1966 about 52 pounds were taken.

Section 3:

Section 3 is 2.3 road miles upstream from Section 2, Figure 1. Construction began in 1963 and was completed in 1964. Preconstruction survey was performed September 8, 1963 and post-construction survey on October 5, 1965. The post-survey showed an average gain in stream width and depth of 7.8 feet and 11.5 inches respectively. Before construction there were four pools, (two good pools, one fair pool and one poor pool) four runs and four riffles. Total length of pools, runs and riffles were 117, 212 and 271 feet respectively. After construction there were three good pools, six runs and three riffles. Total length of pools, runs and riffles were 164, 311 and 125 feet respectively.

Before construction shade cover above the surface of the water was: medium (200-foot) and light (400-foot). The post-survey showed no shade cover above the surface of the water. Both streambanks are riprapped and in almost straight alignment.

Numbers of rainbow and brown trout collected in 1949-51 and 1961-66 are given in Figure 6. Three was no significant decrease in numbers of rainbow and brown trout 7 inches and over. However in 1964 the State Highway Department built three rock jetties. Below each jetty a deep pool was formed which provided cover in the form of depth. These pools were originally classified as type 3 pools (Table 1) because they were scouring basins and lacked overhead cover, undercut banks, aquatic plants or debris piles. Boulders associated with each jetty provided additional cover. It is felt that these jetty-formed pools improved fish habitat over what was present before construction. Numbers of rainbow trout 7 inches and over increased from 9 in 1964 to 27 in 1965 and 47 in 1966. Seven brown trout were taken in 1964, 13 in 1965 and 20 in 1966.

Pounds of trout per acre for 1949-51 and 1961-66 are given in Figure 5. In 1964, 1965 and 1966 about 22, 27 and 57 pounds were taken respectively.

Section 4:

Section 4 is 2.3 road miles upstream from Section 3. A railroad trestle bridges the stream about 35 feet upstream from the bottom of the section. The section was surveyed September 6, 1963. Average width and depth was about 34 feet by 13½ inches respectively. There were two good pools and three fair pools in the section. Total length of pools, runs and riffles were 258, 147 and 195 feet respectively. In the fall of 1963 a bulldozer changed a fair pool into a run beneath the trestle. In the spring of 1964 a good pool was degraded to a fair pool by natural causes.

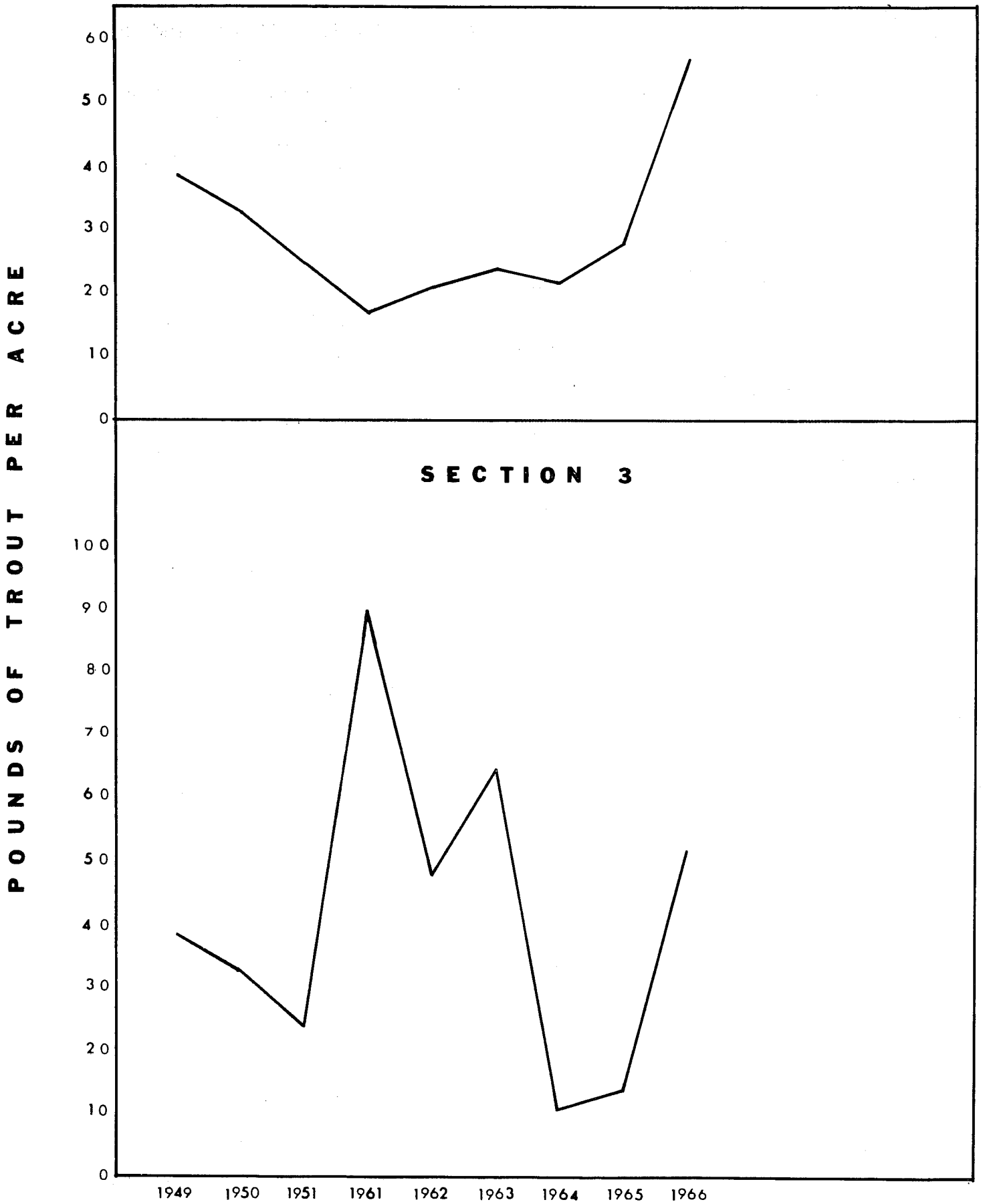
POUNDS OF TROUT PER ACRE
60
50
40
30
20
10
0
SECTION 3
100
90
80
70
60
50
40
30
20
10
0
1949
1950
1951
1961
1962
1963
1964
1965
1966
SECTION 2

Figure 5.

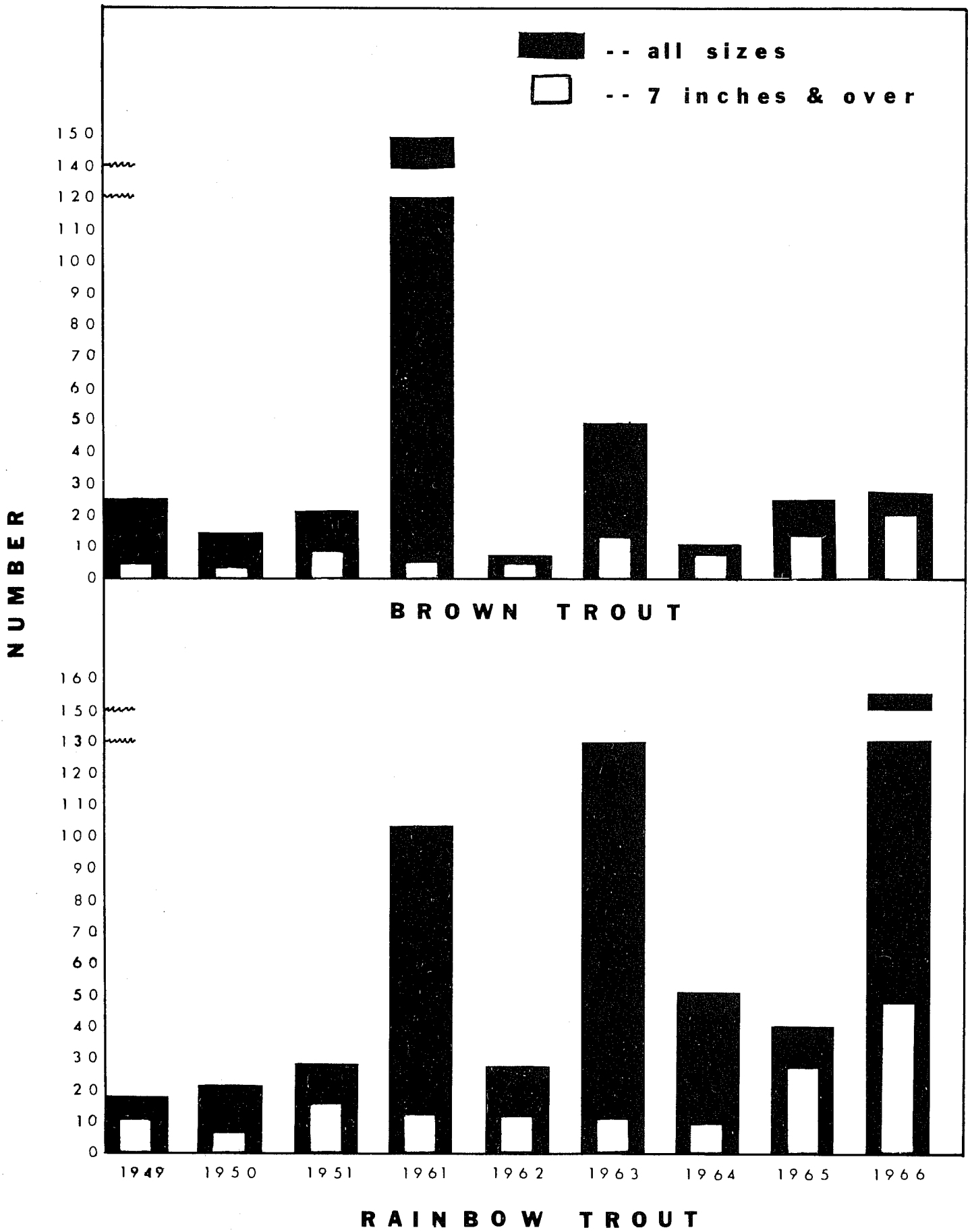
-- all sizes
-- 7 inches & over
NUMBER
150
140
120
110
100
90
80
70
60
50
40
30
20
10
0
BROWN TROUT
160
150
130
120
110
100
90
80
70
60
50
40
30
20
10
0
1949
1950
1951
1961
1962
1963
1964
1965
1966
RAINBOW TROUT

Figure 6.

Shade cover above the surface of the water was: medium 400-foot) and light (200-foot).

Thirteen rainbow trout (7 inches and over) taken in 1964 were slightly below the number taken in 1962 or 1963, Figure 7. Nineteen rainbow were taken in 1965 and 22 in 1966. Nine brown trout (7 inches and over) collected in 1964 represented about half the number taken in 1962 or 1963. Twenty-one brown trout 7 inches and over were taken in 1965 and 30 in 1966.

Pounds of trout per acre decreased to 42 pounds in 1964, Figure 8. In 1962, 1963, 1965 and 1966 collections ran between 60 and 70 pounds per acre. The loss in 1964 is attributed to natural pool degradation and removal of a pool in the fall of 1963 by construction.

Section 5:

Section 5 is about 2.3 road miles upstream from Section 4. The section was not altered by construction of Interstate Highway 15 but one bank had been altered when Highway 91 was constructed. The section was partially surveyed July 12, 1962 and was completed August 8, 1962. Four fair-pools are in the section. The average stream width and depth was about 34-foot by 8 inches respectively.

Shade cover above the surface of the water was: dense (100-foot) medium (400-foot) and light (100-foot).

Numbers of rainbow and brown trout 7 inches and over are given in Figure 9. In 1962, 22 rainbow were sampled; since then their numbers have fluctuated between 5 and 12 fish-quite similar to numbers obtained in 1949-51. Samples of brown trout declined from 37 in 1962 to 4 in 1966.

Approximately 91 pounds of trout per acre were obtained in 1962, Figure 10. Trout poundage per acre declined from 1964-66. Slightly more than 7 pounds of trout per acre were collected in 1966.

Causes of the decline of trout since 1962 could possibly be due to an increase in stream width, with a subsequent loss of undercut banks, and additional deposition of gravel, resulting from construction activities 900 feet upstream. However the section was not resurveyed for it was an unaltered section.

Section 6:

Section 6 is about 2.3 road miles upstream from Section 5. A side road off the Sieben Interchange crosses a small bridge near the head of Wolf Creek Canyon. The bridge is about in the middle of the section. Before construction two good pools were above the bridge; one good pool beneath the bridge; two fair pools just below the bridge and one good pool near the end of the section. Dense willow growth formed a canopy over that part of the stream above the bridge. In the same area both banks were undercut. Below the bridge were good riffle-run-pool combinations. Willow, alder and cottonwood trees provided some bank cover on the west side of the stream, but bank cover on the east side was light.

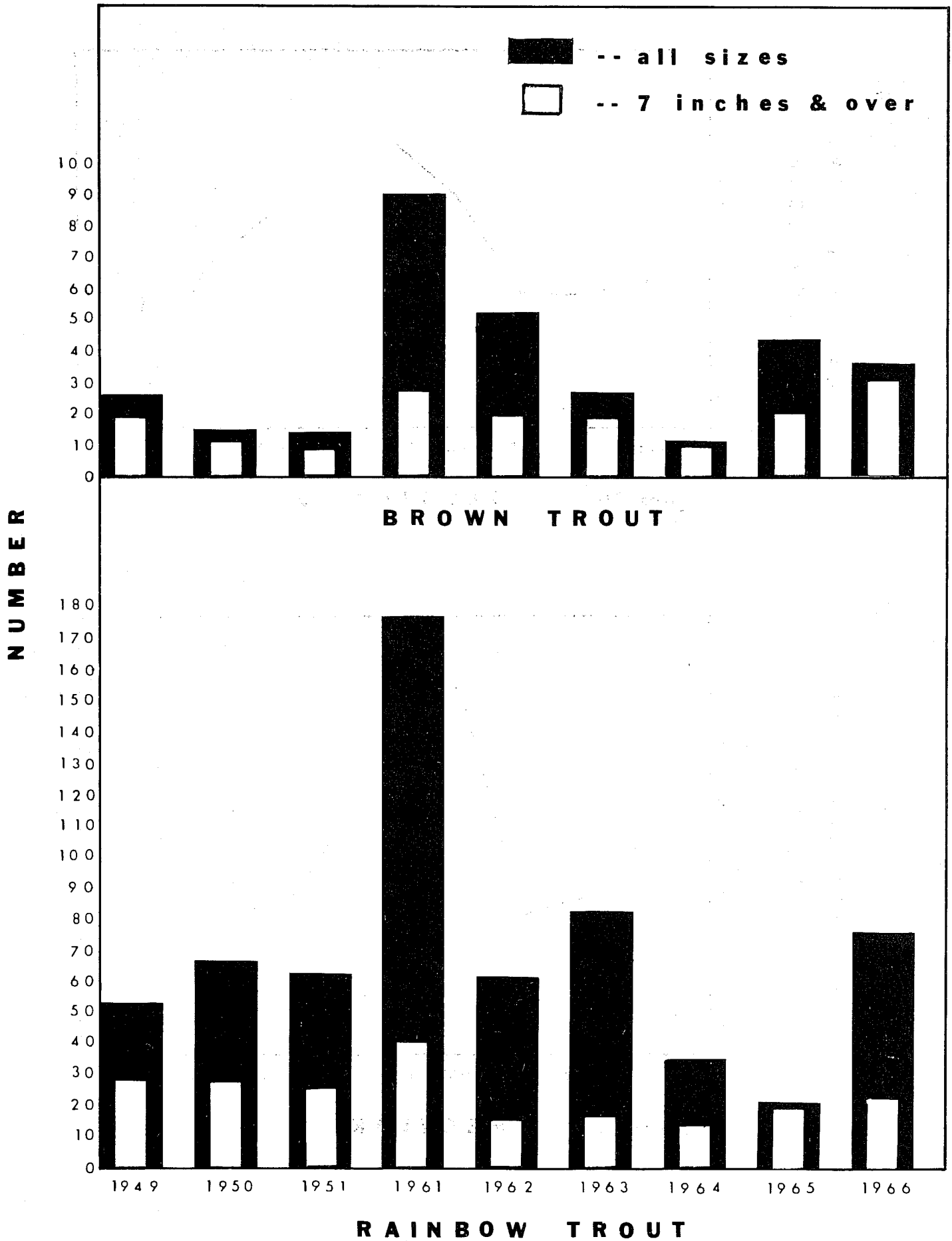
-- all sizes
-- 7 inches & over
NUMBER
BROWN TROUT
RAINBOW TROUT
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
1949
1950
1951
1961
1962
1963
1964
1965
1966

Figure 7.

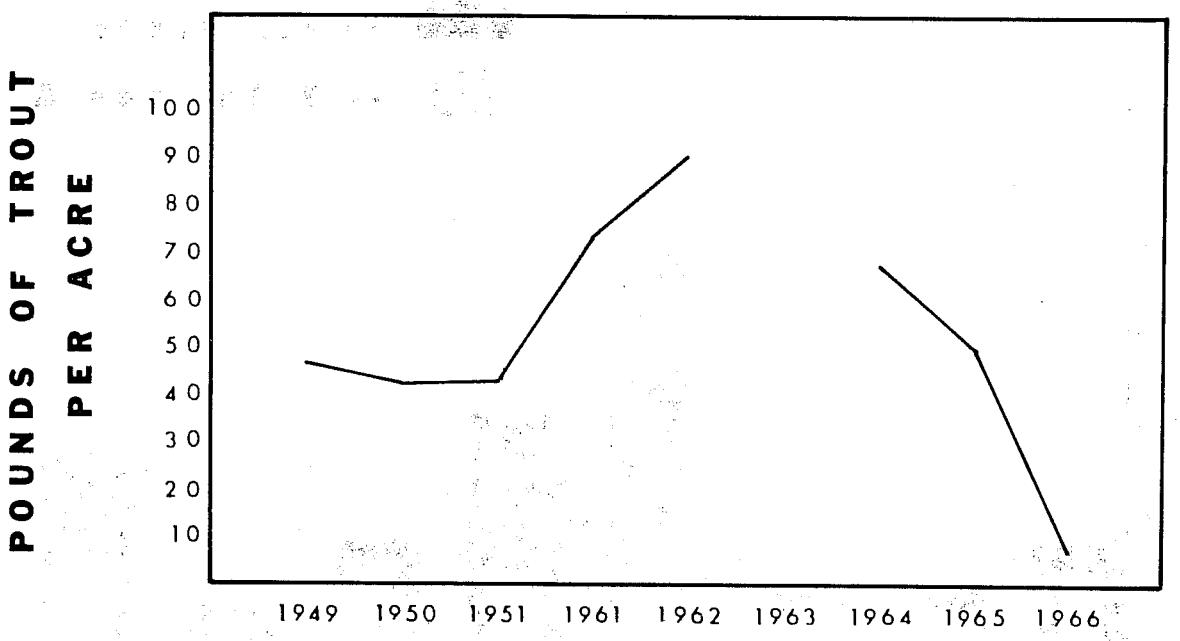

Figure 10. **SECTION 5**

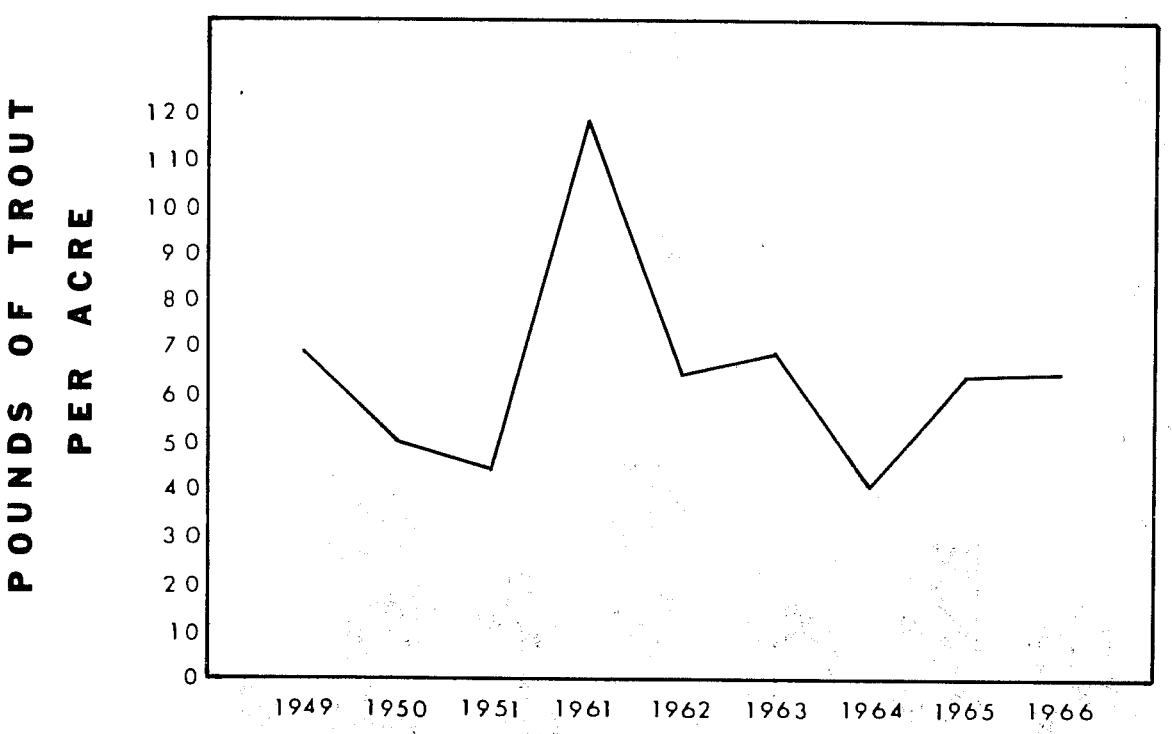

Figure 8. **SECTION 4**

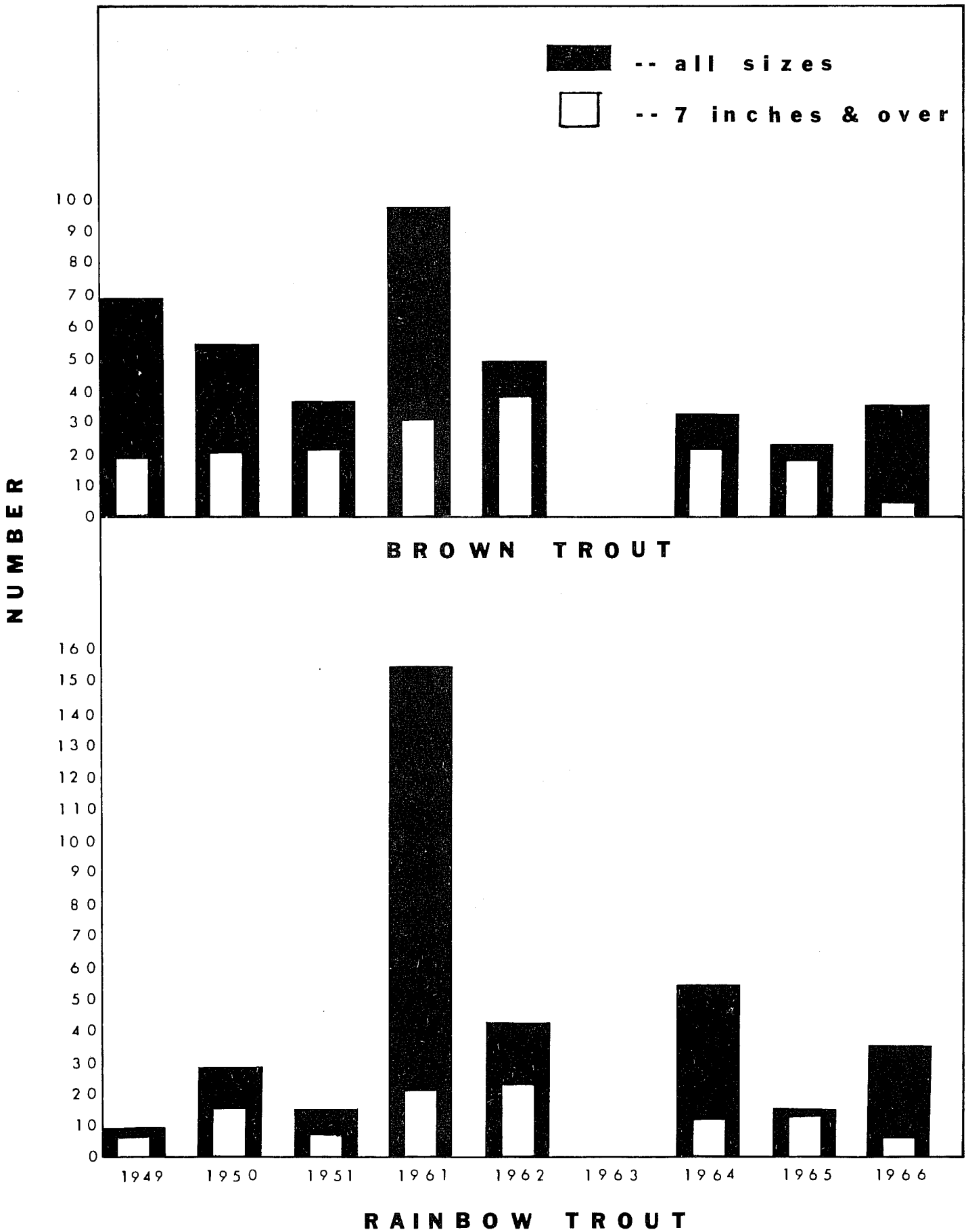

Figure 9.

SECTION 5

Although the section was intended to remain unaltered by construction of Interstate Highway 15 it was affected in 1962. Cover on most of the east bank was cleared off or covered with fill material. Some fill was deposited in the streambed adjacent to the east bank. Otherwise, construction did not alter the habitat. Even now, trout habitat is better than the preconstruction habitat of the other shocking sections.

In 1951 and 1962 collections of rainbow trout 7 inches and over were 11 and 9 fish respectively, Figure 11. In seven other years of sampling 20 to 42 rainbow were taken. Ten brown trout 7 inches and over were taken in 1962. In eight other years of sampling 34 to 74 browns were collected.

About 43 pounds of trout per acre were taken in 1962, Figure 12. In eight other years of sampling the poundage did not drop below 100 pounds of trout per acre.

Fish - All Sections

Average lengths and weights for fish collected in 1965 and 1966 are given in Tables 5 and 6.

Table 7 shows the per cent composition by number for groups of fish collected in 1949-51 and 1961-66. Trout made up 74.6 (1965) to 94.7 (1961) per cent of the total fish population. Species of trout were brown, rainbow, brook and rainbow-cutthroat hybrids (rainbow-cutthroat hybrids were not distinguished from rainbow trout after 1950, for they made up about one per cent of the trout population from 1949-50). From 1949-51 numbers of brown and rainbow trout averaged about 58 and 36 per cent of the trout population respectively. In 1962 brown and rainbow trout comprised about 48 and 44 per cent of the trout population respectively, Table 8. In 1961 and from 1963-66 rainbow outnumbered brown trout by 14; 33; 28; 5 and 33 per cent respectively. Construction appears to have affected rainbow trout less than brown trout. Elser (1967) found rainbow to be the predominant trout in the altered section in Wolf Creek Canyon making up 81 per cent of the total sample. Brook trout, in this study, comprised about 1 to 3 per cent of the trout population in 1961 and from 1963-66.

The average number of brown and rainbow trout taken each year in the 9-year-study was about 253 and 304 respectively. The average total number of trout collected each year in the 9-years of study was about 579. Smallest samples of brown trout were obtained in 1964 and 1965; 116 and 143 respectively. Smallest samples of rainbow trout were taken in 1949 and 1965; 125 and 158 respectively. Smallest samples of trout were obtained in 1964 (329) and 1965 (303).

Species of suckers were the longnose, white and a very few mountain suckers. All of the whitefish were mountain whitefish. Sucker numbers varied from 2.8 per cent (1961) to 23.5 per cent (1950) of the total fish population. Whitefish numbers varied from 1 per cent (1963) to 9.4 per cent (1965) of the total fish

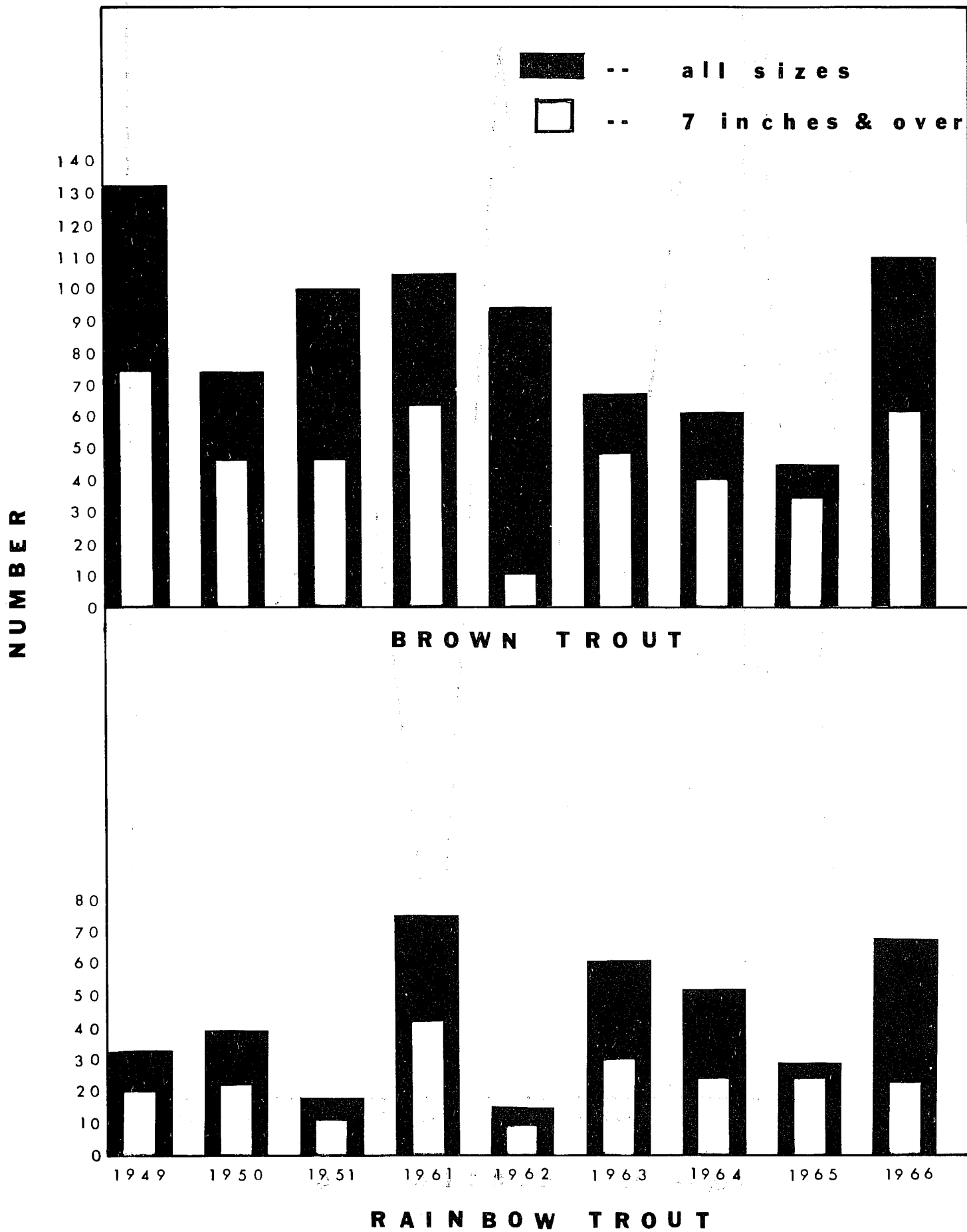
-- all sizes
-- 7 inches & over
NUMBER
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
BROWN TROUT
80
70
60
50
40
30
20
10
0
1949
1950
1951
1961
1962
1963
1964
1965
1966
RAINBOW TROUT

Figure 11.

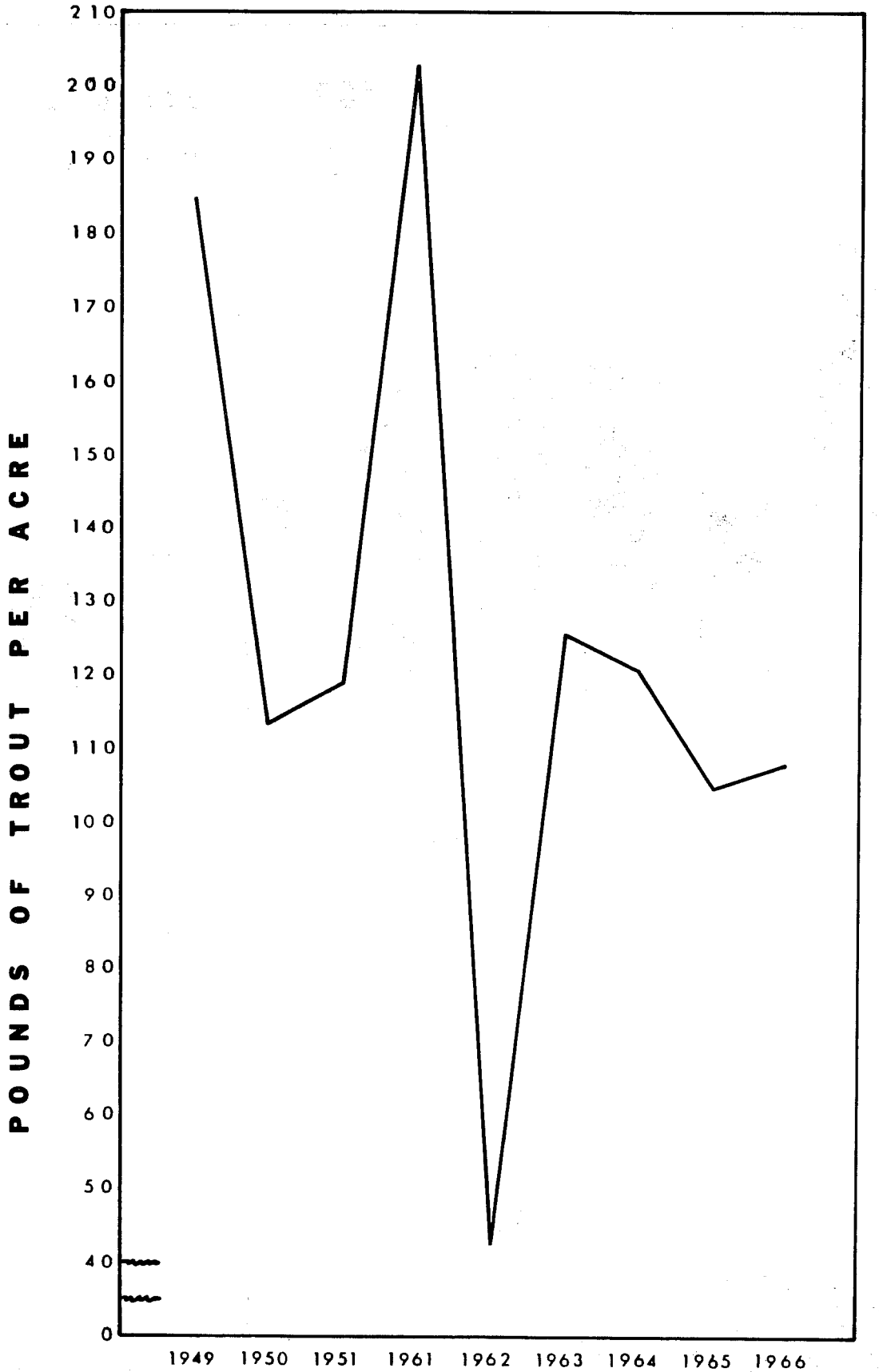
POUNDS OF TROUT PER ACRE
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
0
1949
1950
1951
1961
1962
1963
1964
1965
1966

Figure 12.

Table 5. Electrofishing data collected at five stations in Little Prickly Pear Creek on August 9, 16, 17, 19 and October 27, 1965.

	Species			
	Rainbow Trout		Brown Trout	
Figure	Total length	Weight	Total length	Weight
Total	1,146.3	32.15	1,203.0	56.97
Number	158	158	143	143
Average	7.3	.20	8.4	.40
	Brook Trout		Mountain Whitefish	
Total	12.2	.17	524.1	38.89
Number	2	2	38	38
Average	6.1	.08	13.8	1.02
	Longnose Sucker			
Total	738.7	52.47		
Number	65	65		
Average	11.4	.81		

Table 6. Electrofishing data collected at five stations in Little Prickly Pear Creek on August 8-10, 1966.

	Species			
	Rainbow Trout		Brown Trout	
Figure	Total length	Weight	Total length	Weight
Total	3,376.9	67.74	1,985.2	75.76
Number	550	550	270	270
Average	6.1	.12	7.3	.28
	Brook Trout		Mountain Whitefish	
Total	168.7	3.86	306.0	20.25
Number	26	26	27	27
Average	6.5	.15	11.3	.75
	Longnose Sucker			
Total	302.9	21.15		
Number	33	33		
Average	9.2	.64		

Table 7. Percentage composition by number of fish collected in Shocking Sections 2-6 of Little Prickly Pear Creek, Montana.

Date collected		Per cent composition			
Month	Year	Trout[a/]	Sucker[b/]	Whitefish[c/]	Burbot
August	1949	86.8	9.9	2.3	1.0
August	1950	74.9	23.5	1.3	0.3
September	1951	88.4	8.4	2.8	0.4
August	1961	94.7	2.8	2.5	---
August and September	1962	83.9	12.4	3.7	---
August	1963	89.9	9.1	1.0	---
August and December	1964	81.0	12.7	6.3	---
August and October	1965	74.6	16.0	9.4	---
August	1966	93.4	3.6	3.0	---

a/ Trout: Rainbow, brown, brook and rainbow-cutthroat hybrid.
b/ Sucker: Longnose, white and mountain.
c/ Whitefish: Mountain.

population. Few young-of-the-year suckers and whitefish were taken from 1962-65. It is assumed that most of these fish migrate out of the stream at an early age and re-enter the stream on spawning runs. Stefanich (1951) found quite a variation in the number of suckers and whitefish sampled.

Weights of trout for 1949-51 and 1961-66 fluctuated between 31.1 per cent (1950) and 81.2 per cent (1961) of the total fish population, Table 9. From 1949-51 average annual weights for samples of brown, rainbow and brook trout were about 66.78; 24.84 and 3 pounds respectively. For 1949 and 1950 rainbow-cutthroat hybrids averaged about 2.55 pounds. Sample weights for brown, rainbow and brook trout in 1961 were 99.34; 74.33 and 2.51 pounds respectively, Table 8. Each year during the 9 years of study brown trout weights surpassed rainbow weights; e.g., for years 1962-65 brown trout outweighed rainbow trout by about 18-30 pounds. From 1962-65 brook trout weights declined from 4.94 to 0.17 pounds. During construction years (1962-65) brown trout weights were lowest in 1964 and 1965; 52.58 and 56.97 pounds respectively. During construction years rainbow trout weights were lowest in 1965; 32.15 pounds. In 1966 sample weights for brown, rainbow and brook trout were 75.76; 67.74 and 3.86 pounds respectively.

Total sample weights of all trout for 1949-51 and 1961-66 ranged from 85.10 to 176.18 pounds. Lowest sample yields were about 85 and 87 pounds in 1950 and 1951 and 88 and 89 pounds in 1964 and 1965 respectively. Highest sample yields were taken in 1961 (176.18 pounds) and 1966 (147.36 pounds).

Total sample weights of all suckers for 1949-51 and 1961-66 varied from 8.5 (1961) to 67.6 (1950) per cent of the total fish population. Total sample weights of whitefish for 1949-51 and 1961-66 varied from 0.7 (1950) to 21.5 (1965) per cent of the total fish population.

Scales were taken from several species of fish to determine if construction caused any changes in age composition or growth rate. No change could be determined in either. Average calculated lengths at each annulus show that the growth rate of brown trout exceeded that of rainbow trout, Table 10. Rainbow trout averaged 2.8 inches at annuli I and averaged between 5.5 and 6.7 inches at annuli II. Brown trout averaged between 3.0 and 3.5 inches at annuli I and averaged between 7.1 and 8.2 inches at annuli II. Bishop (1955) reported brown trout to grow faster than rainbow trout in Little Prickly Pear Creek but he found the growth rate of rainbow trout greatest in their first year. Age and growth of rainbow and brown trout were analyzed by individual shocking sections but no significant difference could be detected for years 1962-65. When both species were broken down into sections there were very few fish beyond annuli II.

Table 8. Approximate per cent composition of each species of trout sampled by number and weight, Little Prickly Pear Creek, Montana.

	Rainbow trout				Brown trout				Brook trout				Rb x Ct trout			
Year	No.	%	Wt.	%	No.	%	Wt.	%	No.	%	Wt.	%	No.	%	Wt.	%
1949	125	27.4	25.54	21.7	300	65.8	86.61	73.7	21	4.6	2.29	2.0	10	2.2	3.07	2.6
1950	185	40.1	24.76	29.1	251	54.4	56.51	66.4	21	4.6	1.79	2.1	4	.9	2.04	2.4
1951	169	41.0	24.21	27.8	213	51.7	57.82	66.4	30	7.3	5.03	5.8	0		0	
1961	723	56.0	74.33	43.2	554	42.0	99.34	56.4	25	2.0	2.51	1.4	0		0	
1962	213	44.0	33.39	33.6	232	48.0	60.96	61.4	36	8.0	4.94	5.0	0		0	
1963	402	64.4	33.45	33.0	202	32.4	64.44	63.4	20	3.2	3.67	3.6	0		0	
1964	208	63.2	34.09	38.8	116	35.3	52.58	59.8	5	1.5	1.21	1.4	0		0	
1965	158	52.1	32.15	36.0	143	47.2	56.97	63.8	2	.7	.17	0.2	0		0	
1966	550	65.0	67.74	46.0	270	31.9	75.76	51.4	26	3.1	3.86	2.6	0		0	

Table 9. Percentage composition by weight of fish collected in Shocking Sections 2-6 of Little Prickly Pear Creek, Montana.

Date collected		Per cent composition			
Month	Year	Trout[a/]	Sucker[b/]	Whitefish[c/]	Burbot
August	1949	62.5	28.5	8.3	0.7
August	1950	31.1	67.6	0.7	0.6
September	1951	69.3	25.1	4.6	1.0
August	1961	81.2	8.5	10.3	---
August and September	1962	77.7	12.0	10.3	---
August	1963	77.2	19.0	3.8	---
August and December	1964	71.1	11.4	17.5	---
August and October	1965	49.4	29.1	21.5	---
August	1966	78.1	11.2	10.7	---

a/ Trout: Rainbow, brown, brook and rainbow-cutthroat hybrid.
b/ Sucker: Longnose, white and mountain.
c/ Whitefish: Mountain.

Table 10. Summary of age and growth studies. Fish were collected in Little Prickly Pear Creek, Montana.

Collected Month	Year	Species	I	II	III	IV	V	VI	VII	VIII
8, 9	1962	Rainbow trout	2.8 a/	5.5	8.5	12.7				
			(147)	(35)	(4)	(2)				
				2.7	3.0	4.2 b/				
8 (sub-sample)	1963	Rainbow trout	2.8	6.5	9.1	11.7				
			(82)	(26)	(7)	(3)				
				3.7	2.6	2.6				
8,12	1964	Rainbow trout	2.8	6.7	10.1	13.2				
			(199)	(49)	(10)	(2)				
				3.9	3.4	3.1				
8,10	1965	Rainbow trout	2.8	6.4	8.9	11.8				
			(122)	(74)	(14)	(1)				
				3.6	2.5	2.9				
8, 9	1962	Brown trout	3.0	7.1	11.7	14.6	16.5			
			(81)	(34)	(18)	(7)	(5)			
				4.1	4.6	2.9	1.9			
8 (sub-sample)	1963	Brown trout	3.1	7.7	11.3	13.4	16.3			
			(94)	(42)	(16)	(12)	(2)			
				4.6	3.6	2.1	2.9			
8,12	1964	Brown trout	3.5	7.9	11.8	13.9	13.6	14.7	16.0	
			(87)	(51)	(26)	(10)	(2)	(2)	(2)	
				4.4	3.9	2.1	0.3	1.1	1.3	
8,10	1965	Brown trout	3.3	8.2	11.3	13.6	16.3	18.6	19.6	
			(92)	(46)	(32)	(13)	(4)	(2)	(2)	
				4.9	3.1	2.3	2.7	2.3	1.0	
8, 9	1962	White sucker	1.1	2.7	4.9	8.1	10.1	11.5	12.9	13.5
			(14)	(10)	(8)	(6)	(4)	(3)	(3)	(1)
				1.6	2.2	3.2	2.0	1.4	1.4	.6
8 (sub-sample)	1963	White sucker	1.0	3.0	6.2				IX	X
			(6)	(4)	(1)					
				2.0	3.2				14.9	15.5
									(1)	(1)
8,12	1964	White sucker	1.4	3.6	5.7				1.4	.6
			(2)	(1)	(1)					
				2.2	2.1					

Table 10. Continued.

Collected Month	Year	Species	I	II	III	IV	V	VI	VII	VIII
8, 9	1962	Wf c/	3.6 a/ (6)	6.5 (5) 2.9	9.5 (5) 3.0	11.0 (3) 1.5	13.5 (1) 2.5	15.1 (1) 1.6 b/		
8 (sub-sample)	1963	Wf	3.4 (6)	7.3 (5) 3.9	10.0 (4) 2.7	11.6 (3) 1.6	12.3 (2) .7	12.9 (1) .6	14.1 (1) 1.2	14.9 (1) .8
8,12	1964	Wf	4.3 (23)	8.6 (23) 4.3	11.4 (22) 2.8	13.2 (18) 1.8	14.5 (4) 1.3	16.0 (1) 1.5		
8,10	1965	Wf	4.3 (37)	8.6 (34) 4.3	11.6 (32) 3.0	13.2 (30) 1.6	14.4 (15) 1.2	16.4 (3) 2.0	18.2 (1) 1.8	
8, 9	1962	FSu d/	1.4 (53)	4.1 (44) 2.7	6.9 (16) 2.8	10.3 (5) 3.4	13.6 (2) 3.3			
8 (sub-sample)	1963	FSu	1.3 (55)	3.3 (35) 2.0	5.5 (20) 2.2	8.1 (15) 2.6	10.9 (12) 2.8	13.3 (10) 2.4	14.7 (9) 1.4	15.6 (5) .9
									IX	X
									16.7 (3) 1.1	17.1 (1) .4
8,12	1964	FSu	1.4 (44)	3.9 (32) 2.5	6.1 (16) 2.2	9.8 (4) 3.7	12.7 (1) 2.9	14.8 (1) 2.1	16.0 (1) 1.2	
8,10	1965	FSu	1.4 (63)	4.1 (63) 2.7	7.8 (40) 3.7	10.9 (34) 3.1	12.9 (31) 2.0	15.4 (17) 2.5	16.5 (10) 1.1	16.8 (3) .3

a/ Average total length in inches. The number of fish collected is given in parenthesis.
b/ Increment in inches.
c/ Mountain whitefish.
d/ Longnose sucker.

Discussion - Summary

Construction of Interstate Highway 15 began in the study area in 1962 and was completed by mid-1965. Construction altered different areas of the stream at different times during the construction period. Channel realignment shortened the stream 1.29 miles. The 1.29 miles of stream that were lost included 118 pools, 100 runs and 98 riffles. About 3.7 additional miles of stream were riprapped and diked; degrading most of the streams natural habitat within the altered areas.

The importance of brush cover and undercut banks as trout habitat were discussed by Boussu (1954). Lewis (1967) found that cover regulated the abundance of brown trout and current velocity was most important for rainbow trout. Whitney and Bailey (1959) investigated 350 feet of stream altered by highway construction. They found that construction reduced the number and weight of game fish over 6 inches in total length by 94 per cent. Game fish under 6 inches in total length were reduced 85 per cent by number and 76 per cent by weight.

In this study, construction definitely affected brown and rainbow trout 7 inches and over in Shocking Sections 2 and 6. In Shocking Section 3 the State Highway Department built three rock jetties which caused a deep pool to form below each jetty. It was felt that these jetty-formed-pools created better trout habitat than existed previously, except they lacked overhead cover, debris piles, etc. In Shocking Section 4 a combination of natural pool degradation and man-caused pool degradation could have effected a decline in the trout population. In Shocking Section 5 (unaltered) the decline in trout numbers and weights could have been due to indirect effects of construction on habitat. Data presented in "Fish - All Sections" substantiates many of the relationships discussed previously concerning construction, trout habitat and trout populations. It was found that: (1) Numbers of rainbow trout were less affected by construction than were numbers of brown trout. (2) Annual total sample weights of brown trout surpassed rainbow trout weights. (3) Suckers and whitefish were thought to be migratory; Stefanich (1951), Elser (1967) and Lewis (1967). (4) Investigations concerning water temperatures, bottom fauna and growth of fish could not be related to construction activities.

What was not evident from this study, was: What happens to trout when construction enters their niche - will they move out of the disturbed area, if possible? Within what degrees of construction activity can trout survive? Depth appears to satisfy the requirements for large brown trout in large rivers, such as the Missouri River in Montana and the Deschutes River in Oregon, but can depth in a small stream (without overhead cover) provide sufficient sanctuary for large trout, particularly brown trout?

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