MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

JOB COMPLETION REPORT

INVESTIGATIONS PROJECT

STATE OF: Montana

PROJECT NO: F-5-R-10 NAME: Central Montana Fishery Study

JOB NO: I TITLE: Inventory of Waters of the Project Area

PERIOD COVERED: May 1, 1960 - April 30, 1961

ABSTRACT:

Surveys were conducted on ten streams and nine lakes and reservoirs during the report period. The work consisted primarily of fish population sampling and lake mapping.

In general the streams which provided desirable habitat contained excellent fish populations and in those streams where adequate habitat did not exist game fish were scarce. Water quality data were collected from Belt Creek twice a month for one year to be used as a standard for comparison in the event of future mine-mill pollution. A comparison between total dissolved solids and periphyton growth was made as an aid in establishing an index of productivety to be used throughout the state.

OBJECTIVES:

The purpose of this project is to determine the physical, chemical, and biological characteristics of the waters of highest importance to the total recreational fisheries picture of the project area, and where practicable to obtain estimates of existing or potential fishermen use.

TECHNIQUES USED:

Fish samples were collected with 125-foot experimental gill nets and two electric shockers of 220-volt (AC) and 1,000 volt (DC) capacities. Stream sections of 300 feet were blocked off with nets prior to electro-fishing and at least three runs were made through each section. Age and growth determinations were made

in the Fisheries Laboratory at Montana State College.

Turbidity readings were made with a Hellige Turbidimeter.

Total dissolved solids were determined by the gravametric analysis at the State Board of Health Laboratory and with a specific conductance meter in the field.

Periphyton production measurements were determined by the chlorophyll extraction method as outlined by Grzenda and Brehmer (1960).

Standard methods were used for general water chemistry determinations.

Other agencies contacted, regarding waters under study, were the Soil Conservation Service, Bureau of Reclamation, Geological Survey, Forest Service and various irrigational companies.

FINDINGS:

Streams Surveyed

Eleven streams were electro-fished during the report period. One to three sections were sampled on each stream. Almost without exception the samples showed that game fish populations are directly dependent on the quantity and quality of suitable habitat. Stretches with undercut banks, good brush cover and a meandering channel creating holes yielded the best trout populations. A brief discussion of the more important findings follows.

Big Spring Creek, which runs through Lewistown, Montana, is one of the most heavily fished streams in the District. It's main source is a large spring (constant temperature and flow) approximately seven miles southeast of Lewistown. An annual plant of approximately 35,000 catchable rainbow trout (7-9 inches) are distributed from it's headwaters to about five miles below town. Two 300-foot sections, one above town and one below town were electro-fished in September following the peak of the 1960 fishing season. Accessability for the non-portable shocker was the primary consideration in selecting these sections. Deep holes in the lower section made recovery difficult, therefore, the number of fish taken is unreliable as an estimate of the population.

The game fish taken from the upper section included 118 rainbow and 6 brown trout. Considering all fish over 6 inches in length, 71 per cent were rainbow, 5 per cent brown and 24 per cent suckers. Of the rainbow over 6 inches, 38 per cent were planted fish identified by eroded fins and scale characteristics. Reproduction is apparently excellent since one-third of the rainbow collected were less than 6 inches and the efficiency in collecting small fish was low. Table 1 summarizes the data from the two sections.

Table 1. A Summary of Electro-fishing Results in Big Spring Creek, September, 1960

Sp.	No. Adults	No. Young	% No.	% Lbs.	Length X	Length Range	Weight X	Weight Range
			Upper 300 Feet (above town)					
Rb	79	39	71.1	47.3	10.5	6.0-17.4	.56	.10-2.21
LL	5	1	4.6	13.7	17.8	10.7-20.1	2.58	.47-3.35
F Su	25	2	22.5	37.6	14.8	11.2-18.6	1.42	.63-2.48
C Su	2	0	1.8	1.4	11.4	11.1-11.7	.63	.54- .73
			Lower 300 Feet (below town)					
Rb	33	0	20.4	16.0	12.3	7.4-21.3	1.02	.17-3.83
LL	9	1	5.6	4.4	12.0	5.0-20.4	.92	.06-3.45
Wf	9	0	5.6	7.0	15.8	13.4-17.7	1.63	1.17-2.19
F Su	87	-	53.7	59.3	15.8	13.6-18.0	1.44	.86-1.94
C Su	24	-	14.7	13.3	13.5	13.3-17.5	1.17	1.12-2.68

Rb = Rainbow trout
LL = Brown trout
F Su = Longnose sucker
C Su = White sucker
Wf = White sucker

Two sections on the Musselshell River were electro-fished in September, 1960. One section near Harlowton and the other above Twodot. Due to irrigational demands and unstable releases from the two upstream impoundments, flow conditions in the lower Musselshell during late summer were critical for trout.

In the station near Harlowton trout comprised less than 0.5 per cent of the population excluding small fish (chubs, dace, etc.). Low water flows resulting in decreased trout habitat is partly to blame for this condition. Brush cover was Scarce in the lower section. The benefit derived from what little brush cover that did exist was aggravated by the low water condition.

In the upper section, where brush cover was more abundant, trout comprised 22 per cent of the fish collected excluding small fish. The trout consisted of 56 browns and 6 rainbows in the two sections combined. All of the rainbow had eroded fins which identified them as hatchery fish.

Three 300-foot sections were electro-fished on Belt Creek, a very important recreational stream southeast of Great Falls. The section located in the upper canyon yielded the most substantial game fish population; 28 rainbow and 25 whitefish. Deep holes made recovery difficult in this section, however. Adequate flows prevail in the canyon section and inaccessibility has left the stream habitat, for the most part, unaltered. This is not the case in the sections above and below the

canyon. The highway parallels the stream above the canyon and has been responsible for much of the habitat being lost. A section (300 feet) of what appeared to be some of the best habitat above the canyon yielded only 4 rainbow and 4 brook trout. The section below the canyon yielded more trout due to more holes and brush cover, however, below the canyon the stream suffers from low flows nearly every summer. Low flows were observed in the upper part of the canyon (below Monarch) this year, some stretches were dewatered nearly to the point of drying up. It is recognized that a Fish and Game Department controlled regulating reservoir on the headwaters, to stabalize stream flow, is one answer to the fishery problem in lower Belt Creek.

Lakes Surveyed

Surveys were conducted on nine lakes and reservoirs during the report period and for the most part involved fish population sampling and mapping.

Two overnight gill net sets were made in Bynum Reservoir, in January, to evaluate the size and growth rate of yellow perch. The fisherman catch was also sampled, at the same time to compare with the gill net catch since some sportsmen felt that angling had demonstrated perch were larger than the nets had indicated. The average lengths of 65 perch taken in gill nets and 77 taken by anglers were 7.0 and 6.8 inches respectively. Figure 1 is a length-frequency histogram illustrating little difference in the two samples.

Creel checks at the annual perch derby on Bynum, January 30, 1955, showed a mean length of 11.4 inches for a sample of 87 perch. Apparently over population has resulted in a decrease in size of the perch and rehabilitation in favor of trout is recommended. Since Bynum Reservoir is approximately 3,200 acres, toxaphene would be the most economical chemical to use. It was sounded and mapped for the purpose of rehabilitation.

Two gill net sets were made in Stafford's Reservoir near Winifred in November, 1960. The catch was comprised of 20 bluegills, 10 rainbow trout and 1 largemouth bass. The mean length and weight of the bluegills was 6.3 inches and .23 pounds which is considered good size in relation to other warm water fish ponds in Montana. The mean length and weight of the trout was 13.0 inches and .86 pounds. The reservoir had an annual plant of catchable rainbow trout until 1960 when no plant was made in anticipation of possible rehabilitation. Rehabilitation has been postponed and the reservoir returned to the catchable planting program due to public opposition to rehabilitation and the desirable size of the bluegills. Future management will depend on the bluegill population, if they over-populate and become smaller, rehabilitation will again be proposed.

Creel census was taken January 1, 1961 (opening day of a two month season) at Holliday Lake near White Sulphur Springs. The total number of fishermen checked was 72 and they caught

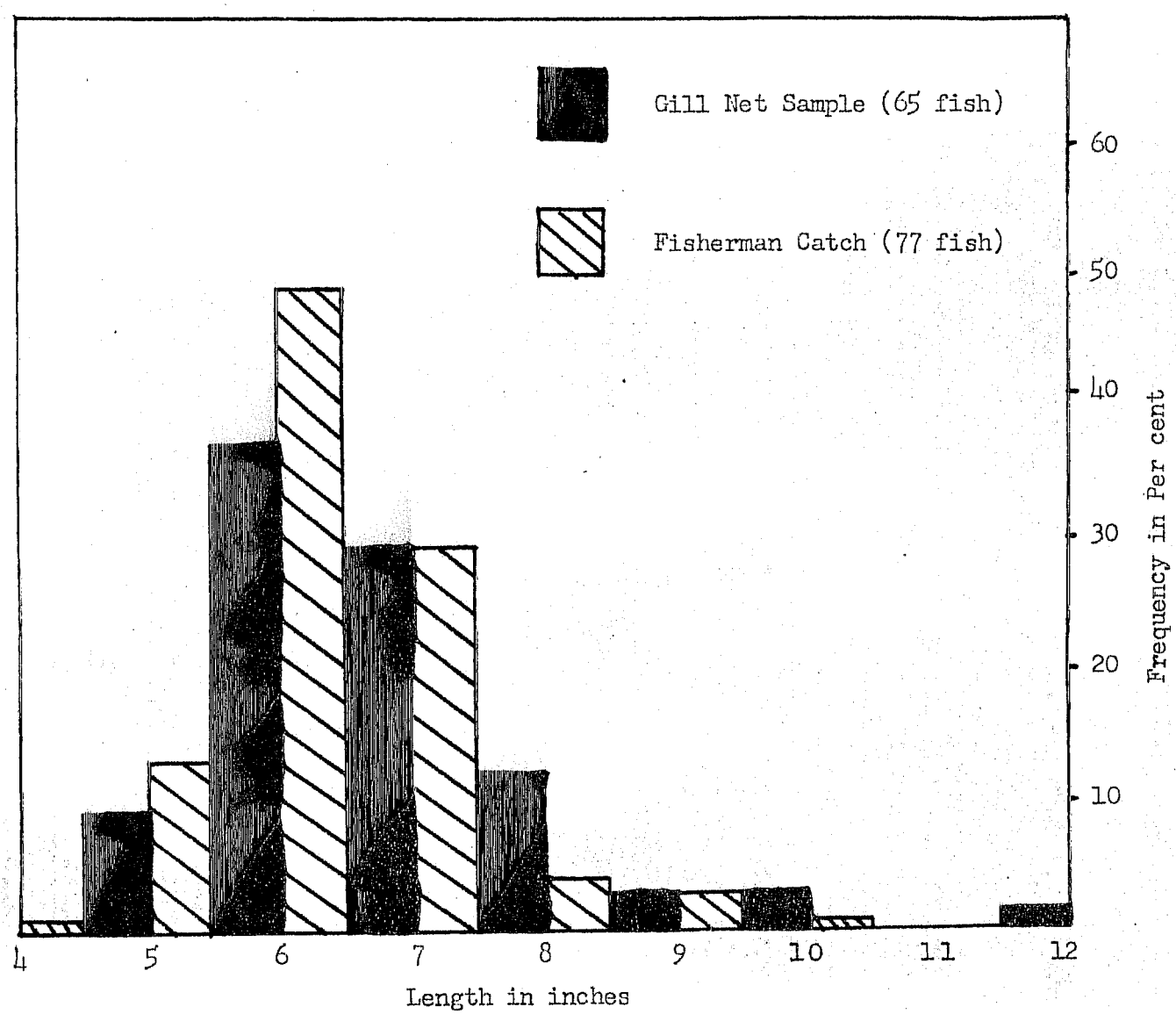

Fig. 1. Length-Frequency histogram comparing yellow perch taken from Bynum Reservoir by hook and line and by gill nets in December, 1960.

212 fish for a catch per hour of .79. Rainbow and cutthroat comprised a larger percentage of the catch this year than in any previous sample. In the past the brook trout contribution was from 62 to 73 per cent and the balance was rainbow and/or cutthroat. This year the catch was 47 per cent rainbow, 44 per cent brook and 9 per cent cutthroat. The brook trout averaged 12.5 inches, the rainbow 14.7 and the cutthroat 15.2 and all were in better condition than in 1960. It was thought that the decrease in mean length of brook trout from 14.4 in 1954 to 10.8 in 1960 was mainly due to under harvesting since the lake has only been open for one month every other year until 1960 and 1961 when it was open for two months. The reason for the increase in size and condition of brook trout and increased proportion of rainbow in the 1961 catch is not known. However, several possibilities exist; (1) the larger size and better condition reflected a long season and larger harvest, (2) a less severe draw-down in 1960 or (3) the sample is unrepresentative. Information will continue to be gathered to follow trends in this population.

Two overnight gill net sets were made in Lake Francis in February, 1961. The catch consisted of 86 per cent suckers, 4 per cent rainbow trout, 3 per cent kokanee, 2 per cent whitefish, 2 per cent ling, and 3 per cent yellow perch. This is the first authentic record of perch in the lake. It is believed northern pike have also been illegally introduced but as yet none have been caught.

The fish populations were checked in Cameron and O'Haire Reservoirs, near Sunburst, Montana, in August, 1960. Rainbow trout were the only fish taken in gill nets. Rough fish (i.e. suckers) were not taken and from all indications do not exist in the two reservoirs. The annual trout plants were altered to conform to the size of the reservoirs.

Surprise Creek Reservoir, west of Stanford, was sampled in April with two gill nets. The population was found to consist primarily of suckers. A plant of 5,000 catchable-size Yellowstone cutthroat trout was made in May since a furunculosis infection was causing high mortalities in these fish in the hatchery. Excellent fishing was created throughout the summer. The reservoir was rehabilitated in September with state funds. It was netted following chemical treatment and no fish were caught which suggested a complete kill had been attained.

Hidden Lake, located on the headwaters of the Teton River, was surveyed in 1959 and planted the following fall with cutthroat fingerlings. A fish kill was reported in July, 1960 and investigated. Sculpins were the only species found dead around the shore, however, live sculpins were abundant. No trout were taken in the nets so the success of the plant is not known. An additional plant was made in 1960 with larger fish.

Two overnight gill net sets were made in Lower Mission Lake, west of Cut Bank. The catch (224 fish) consisted of 86 per cent suckers and 14 per cent rainbow trout by weight and

numbers. The trout were in excellent condition and showed good growth in spite of the dominant sucker population. Considerable enthusiasm was shown by the Glacier County Sportsmen's Association for rehabilitation. If rehabilitation is planned, the plant will be discontinued for two years prior to chemical treatment.

The sucker population is also a problem in Nilan Reservoir. Two gill net sets in March showed a catch of 62 fish; 87 per cent suckers and 13 per cent trout by weight and 85 per cent suckers and 15 per cent trout by number. Within the next two years rehabilitation would be desirable since Willow Creek Reservoir, in the same vicinity, is expected to produce good fishing in the near future, and thereby decrease the need for the fishing in Nilan. Willow Creek Reservoir was rehabilitated in 1959.

Productivity Index

Further work was done on comparing total dissolved solids (TDS) with periphyton production in streams. A correlation analysis was run on 38 samples collected during 1959 and 1960. A correlation coefficient of .55 was calculated which was found to be not significantly different from 0 at the 5 per cent level.

It was originally thought a positive correlation between periphyton production and TDS would lend support to the use of TDS as an index to productivity throughout the state. This would be desirable since the latter method involves less effort.

Belt Creek Water Quality

A year's data were collected at eight stations on Belt Creek regarding turbidity, total dissolved solids, temperature, pH and periphyton production. Samples were collected twice each month. Previously, two years (1957 and 1958) data were collected on turbidity thus making a three years total of turbidity readings. These data are summarized in Figures 2 and 3.

It is hoped that the information gathered will help to quantitatively measure the effect on the stream of any future mine-mill pollution. A picture of the normal stream condition was somewhat obscured at times during the fall of 1960 due to highway construction in the vicinity of the Jefferson Creek station (furthest station upstream). Large amounts of sediment that were introduced into the stream as a result of channel changes had a definite effect on turbidity (readings of 63 ppm were obtained, normal is below 0.5 ppm) and periphyton production measurements in addition to creating unsuitable conditions for bottom fauna and trout spawning.

Stream temperatures in Belt Creek ranged from 32° F. (Fahrenheit) at most stations in water to between 50° F. and 60° F. in the summer. A temperature of 76° F. was recorded in July below the mouth of the Dry Fork, at that time the temperature was 63° F. just upstream from the mouth. The Dry Fork con-

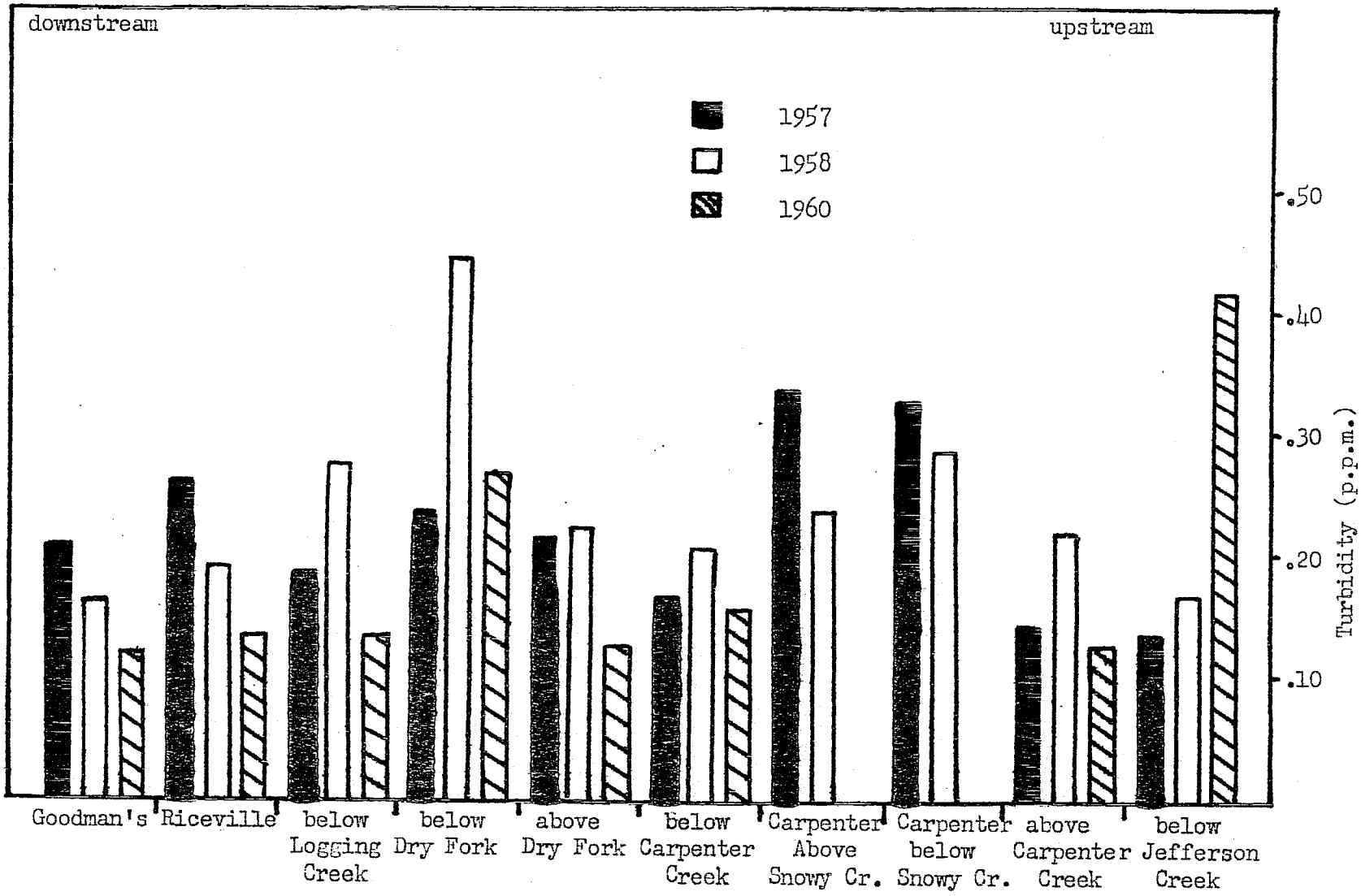

Fig. 2. Mean annual turbidity readings for each station on Belt Creek during 1957, 1958 and 1960, (samples taken twice each month).

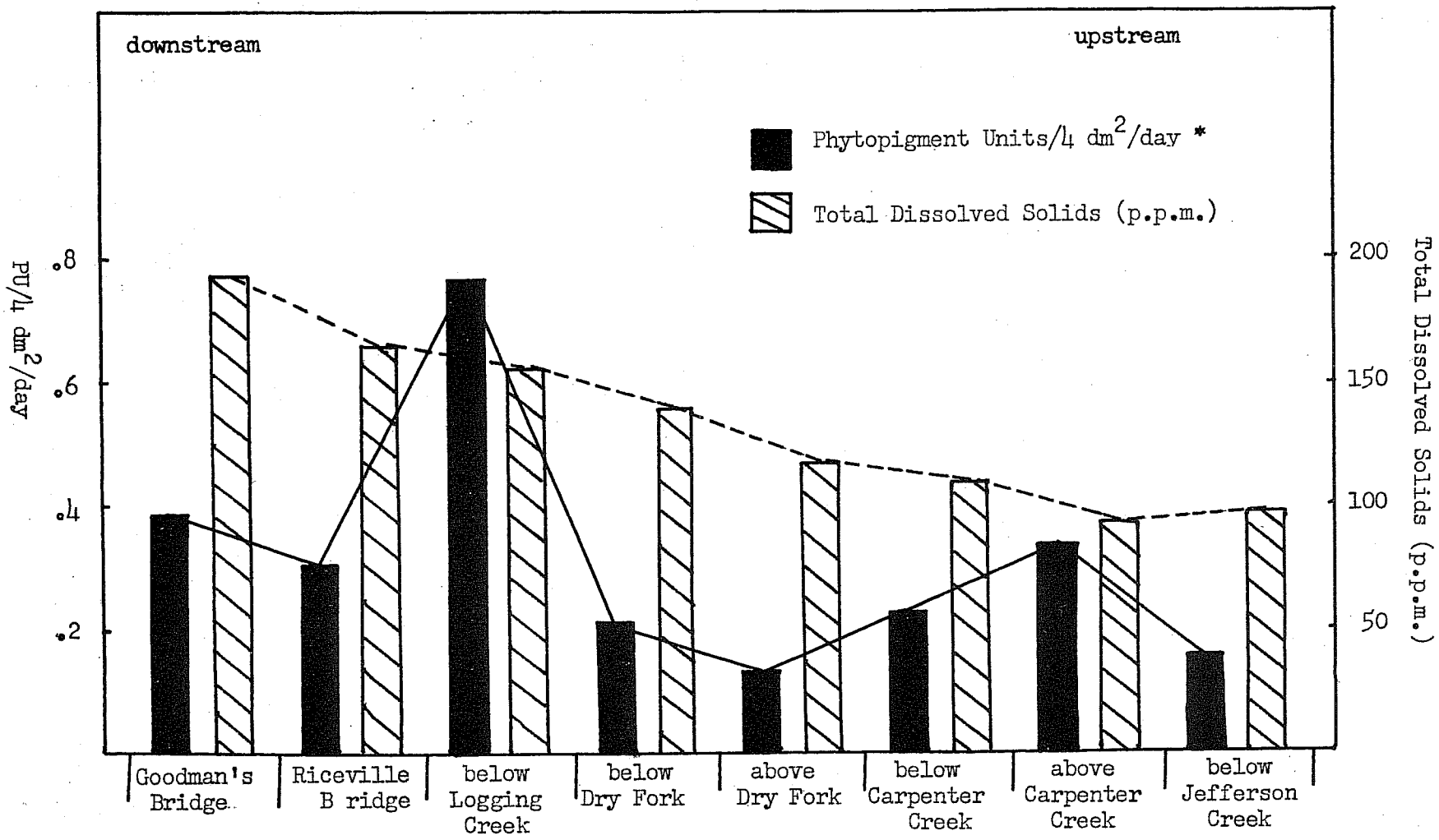

Fig. 3. Mean annual periphyton production (as phytopigment units or chlorophyll optical density) and total dissolved solids readings at eight stations on Belt Creek sampled twice each month during 1960.

* Phytopigment Units (PU) or chlorophyll optical density X 10^2/4 dm^2/day.

sistently has a warming effect on Belt Creek probably due to the large amount of exposed area on the upper Dry Fork. The Dry Fork also carries a considerable load of sediment which is washed into the stream from several abandon mine-mill waste deposits. The Forest Service may consider constructing several devices to contain this material.

Hydrogenion readings on Belt Creek ranged from 7.2 in high water conditions to 8.0 in low water at the station furthest down stream.

There was practically no relationship shown between total dissolved solids and periphyton production at the eight stations sampled (Figure 3). The mean annual water temperature was 4° F. higher below Logging Creek than at any of the other stations. This station also showed the highest periphyton production (Figure 3) which helps to show the effect of water temperature on basic production.

RECOMMENDATIONS:

Compilation of a complete file of information regarding all Montana waters should be continued in order to formulate future fishery management procedure and recommend investigations on problems of a more comprehensive nature.

SUMMARY:

1. Fish populations were sampled in ten streams in the District. Big Spring Creek is an outstanding example of excellent trout habitat and electro-fishing demonstrated ideal game fish populations. On the other hand, the Musselshell River was hurt badly with low flows and this situation was exhibited by the abundance of the game-fish where adequate flows and brush cover prevailed and scaracity of game-fish in areas where low flows had been detrimental.

2. Fish populations were sampled in nine lakes and reservoirs in the District. The existing populations in Bynum, Francis, Mission and Nilan Reservoirs indicated rehabilitation would be desirable. At present, Bynum is the only one considered for 1961.

3. Total dissolved solids and periphyton production data were compared with a correlation analysis. This was done to provide support for the use of TDS as an index of fertility throughout the state. A significant correlation was not found, however.

4. The collection of water quality data at eight stations on Belt Creek was concluded during the report period. Data concerning TDS, turbidity, temperature, pH and periphyton production were summarized.

DATA AND REPORTS:

The original data and reports are filed in the fisheries office at the District Headquarters in Great Falls.

REFERENCES CITED

Grzenda, Alfred R. and Morris L. Brehmer. 1960. A quantitative method for the collection and measurement of stream periphyton. Limnology and Oceanography. Vol. 5, No. 2. April, 1960.

Prepared by: Eugene B. Welch

Aproved by: George D. Holton

Date: April 30, 1961

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECT

STATE OF: Montana

PROJECT NO: F-5-R-10

JOB NO: II

NAME: Central Montana Fishery Study

TITLE: Investigation of Effectiveness of Marias River Rehabilitation above Tiber Reservoir, Five Years After Rehabilitation

PERIOD COVERED: May 1, 1960 - April 30, 1961

ABSTRACT:

Fish populations were sampled during October, 1960, in Cut Bank Creek and Two Medicine River by electro-fishing. In general, trout were found to be scarce in the lower sections of these streams. Shocking done in the upper sections of Cut Bank Creek in 1958 showed an abundance of trout. Ling were numerous at the three lower sections sampled. Suckers and forage species were abundant in every section sampled, but no carp or goldeye were found.

OBJECTIVES:

The objectives of this investigation were to determine the completeness of non-game fish removal, the extent of fish population recovery and the status of the trout fishery in the Marias River Drainage above Tiber Reservoir.

TECHNIQUES USED:

Stream sections 300 feet in length were blocked off and electro-fished with a 1000-volt, 5000-watt DC shocker. It operated at 400-500 volts and 5-8 amps in this water. The fish were weighed, measured and scales taken for age and growth determinations.

FINDINGS:

In September, 1958, five sections were shocked on upper Cut Bank Creek from the Glacier Park boundary to the Babb road north of Browning. The two sections between the Park boundary and the mouth of the South Fork Cut Bank Creek, together, only produced 14 trout. Other species of fish were also few in number with the exception of sculpins which were abundant. In one section in the South Fork and two sections below the mouth of the South Fork, trout and other species of fish were numberous (Table 1). It was thought at the time this difference in fish abundance might be due to water fertility. Total dissolved solids (TDS) and periphyton production measurements were taken at the Park boundary (5 miles above mouth of South Fork) and the Babb road (5 miles below mouth of South Fork) in the fall of 1960 and are listed in Table 1. Some difference in water quality is shown between the two stations but whether it is significant cannot be determined from the one series of samples (Table 1).

Table 1. A Summary of Shocking Data Collected on Cut Bank Creek in 1958 and Water Quality Data Collected in 1960

	Rb*	Eb*	Wf*	Mt. Su*	F Su*	Sculpin	Alk. PPM	TDS PPM	PU/ 4 dm^2/ day **
5 mi. above So.Fk.	4	0	0	Mod. abundant	none	abundant	84	147	.47
3 mi. above So.Fk.	5	6	0	abundant	3	abundant	117		
2 mi. below So.Fk.	37	21	37	105	41	abundant			
5 mi. below So.Fk.	38	21	52	abundant	abundant	mod. abundant	140	203	.67

* Rb = Rainbow trout
Eb = Eastern brook trout
Wf = Whitefish
Mt. Su = Mountain sucker
F Su = Longnose sucker

** Phytopigment Units (PU) or chlorophyll optical density X 10^2/ 4 dm^2/ day.

Based on the 1958 sampling it was concluded that trout abundance and natural reproduction had come back strong following rehabilitation in the upper portion of Cut Bank Creek. In September, 1960, the lower portion of Cut Bank Creek and Two Medicine River were sampled. Trout were not found to be abundant in the lower portions as they were in the upper portions. Only 14 trout were taken in four sections sampled in lower Cut Bank Creek. The sections were located 15 and 36 miles below the mouth of the South Fork, directly below the water intake dam and below the bridge at Cut Bank. The largest concentration of trout (9 rainbow) and whitefish (33) was found below the water intake dam. Ling were abundant at the three lower sections sampled, comprising 21 per cent of the total population. They ranged in length from 9 to 29 inches. Rough fish were most abundant below the

bridge at Cut Bank. Here 61 white suckers, 78 longnose suckers, 48 mountain suckers and numerous chubs were taken.

Two Medicine River was sampled approximately eight miles above and 15 miles below Highway 89. No trout, 4 whitefish, 38 chubs and 145 suckers were taken at the lower station and 4 planted trout, 8 whitefish, 27 suckers and 8 chubs were taken at the upper station. Deep water limited shocker effectiveness at the upper station, therefore little confidence is placed on that sample.

Prior to rehabilitation, carp, suckers and goldeye were the dominate fish species in these two streams. No reports have been made of carp or goldeye in these streams since the completion of that project although the presence of carp has been substantiated in Tiber Reservoir. Ling were never recorded in such abundance prior to rehabilitation.

RECOMMENDATIONS:

Consideration has been given to opening Cut Bank Creek, below the water works dam, to set line fishing to utilize the flourishing ling population. The Glacier County Sportsman's Association were contacted and have expressed favor to such a regulation change.

It is further recommended that investigations be made to determine the factors limiting trout in lower Cut Bank Creek. The first step could be a program to determine whether or not suitable conditions exist for reproduction.

SUMMARY:

Six stream sections, each 300 feet in length, were sampled in lower Cut Bank Creek and Two Medicine River in September, 1960. Trout were relatively scarce compared to numbers found in sections sampled further upstream on Cut Bank Creek in 1958. Ling were found to be abundant in lower Cut Bank Creek. In order to utilize this ling population, consideration should be given to legalizing set line fishing below the water intake dam.

DATA AND REPORTS:

The original data and reports are in the fisheries office of the District Headquarters in Great Falls, Montana.

Prepared by: Eugene B. Welch Approved by: George D. Holton

Date: February 27, 1961

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECT

STATE OF: Montana

PROJECT NO: F-5-R-10 NAME: Central Montana Fishery Study

JOB NO: III TITLE: Investigation of Previously Rehabilitated Waters in the Project Area with Regard to Fish Growth and Optimum Size to use in Successive Plants

PERIOD COVERED: May 1, 1960 - April 30, 1961

ABSTRACT:

Fish populations in four rehabilitated reservoirs were sampled with experimental gill nets. In general, trout growth was found to be outstanding. In three of the rehabilitated reservoirs the initial plant of fingerling rainbow averaged 1 or more inches growth in length per month through the first year. In Willow Creek Reservoir trout in the initial plant averaged 12.9 inches after the first nine months. Prior to rehabilitation they barely attained this growth in two years. Eureka Reservoir was substantially underplanted as evidenced by the slow rate of catch and tremendous growth of the fish. It has been necessary to rehabilitate it again and the following initial plant will be increased by 50 per cent in the hope of increasing the catch. It is anticipated an increased plant will reduce the growth rate.

OBJECTIVE:

The objectives of this investigation are to evaluate the rehabilitated waters in terms of fish growth, completeness of rough fish eradication and the most satisfactory size fish to use in making successive plants. The various plants in Ackley Reservoir will be marked to aid in distinguishing year classes of fish in future sampling.

TECHNIQUES USED:

Fish samples were collected during the winter months with the aid of 125-foot experimental gill nets. The right pectoral

fin was clipped from the 1960 rainbow plant in Ackley Reservoir. Creel census information was taken from fisherman logs and warden reports.

FINDINGS:

Rehabilitated reservoirs which were sampled during the past year included; Ackley, Eureka, Willow Creek and Kolars No. 2. Table 1 summarizes the history and planting of these waters since rehabilitation. The findings on each reservoir will be discussed separately.

Table 1. A Summary of Fish Planted and Sampled from Rehabilitated Waters in 1960-61

Reservoir	Rehabilitated	Fish Plants				Date Sampled	$\bar{X}$ Lth.	$\bar{X}$ Wt.	$\bar{X}$ Gain/mo. Lth.	$\bar{X}$ Gain/mo. Wt.
		No./Acre	Date	Sp.	Size					
Ackley	1958	365	4/59	Rb	3	12/59	13.2	1.13	1.28	.14
		175	9/59	Eb	5	2/61	12.6	.71	.48	.04
		101	5/60	Rb	4	2/61	10.3	.45	.70	.05
Eureka	1958	322	5/59	Rb	3	10/60	19.9	4.05	.99	.24
Willow Cr.	1959	170	5/60	Rb	3	2/61	12.9	.89	1.04	.09
Kolar No. 2	1959	890	5/60	Rb	3	1/61	8.3	.20	.66	.02

Rb = Rainbow trout
Eb = Eastern brook trout

Ackley Reservoir

The rehabilitation of Ackley Reservoir was completed in 1958 and it was planted as indicated in Table 1. No rainbow trout from the initial plant, following rehabilitation, were taken through 1960 by standard sampling procedures. The initial plant was made earlier than recommended, due to crowded conditions in the hatchery. Sufficient fish-food had not yet returned in the lake to insure good survival.

The species composition in the total catch (creel census and gill nets) since rehabilitation has been 78% brook trout, 11% rainbow trout from the 1960 plant and 11% rainbow from the 1959 plant, while the number of rainbow planted has been nearly three times that of brook. These data do not include the period October through December when large numbers of brook were harvested. They were in spawning condition and concentrated close to shore and were, therefore, easily accessable to the angler.

Following this apparently large brook trout harvest in the fall, seven gill net sets made during January and February yielded a catch of 30 brook, 3 rainbow from the 1960 plant and no rainbow from the 1959 plant. Apparently good numbers of brook were still present. Excellent catches of rainbow from the 1960 plant have been reported during the spring of 1961 with few reports of

rainbow from the 1959 plant being taken. It becomes increasingly apparent a low survival of the initial plant of rainbow (1959) was experienced, probably due to an insufficient food supply.

The 1960 plant of rainbow trout was made under better conditions and were larger size than the 1959 plant, however, the 1960 fish are not showing the exceptional growth (Table 1). It is possible this is due to a larger standing crop of fish in 1960 creating more competition.

A few longnose suckers averaging 7.0 inches in length have been taken recently, indicating the sucker population is returning.

Eureka Reservoir

It was necessary to rehabilitate Eureka Reservoir in October 1960 only two years following the initial rehabilitation. This was due to a drawdown to dead storage. A damaged outlet works prompted this action by the irrigation company.

In the poisoning operation, 64 trout were picked up, weighed and measured. Their mean length and weight was 19.9 inches and 4.05 pounds respectively. These fish had been planted only 17 months earlier as 3-inch fingerlings. It is believed the growth rate of the initial plant in Ackley Reservoir is very similar to this, however, the only information on the size of these fish during the summer of 1960 came from fishermen reports.

Based on the fast growth of the fish and the slow fishing reputation it had during the summer it is believed Eureka Reservoir was considerably underplanted. The planting rate will be increased this coming spring from 322 fingerling rainbow per acre to 500.

Willow Creek Reservoir

Rehabilitation of Willow Creek Reservoir was completed in the fall of 1959. It was planted with 3-inch fingerlings at the rate of 170 per acre in May 1960 (Table 1). It was thought to be relatively unproductive due to the barren shoal areas and sparse aquatic vegetation. Therefore, it was planted at a low rate.

The first sampling in February 1960 yielded 9 trout of excellent condition (12.9 inches average length and 0.89 pounds average weight) and no suckers. The growth of this initial plant compares rather closely to that of trout in Ackley and Eureka Reservoir. In nine months the fish in Willow Creek Reservoir gained nearly as much in length as previous fingerling plants (prior to rehabilitation) had in two years (Table 2). The fish were gorged with a variety of food items consisting of; leeches, scuds (1/2-3/4-inch), caddisfly larvae, cladocerans and copepods.

Reports by fishermen indicated fishing was good during late summer and early fall and hopes are high for good fishing in the summer of 1961.

Table 2. Age and Growth of Trout Taken from Willow Creek Reservoir in 1951 and 1959 (Prior to Rehabilitation)

Trout Species	Date		Age I	Age II	Age III	Age IV
Rainbow	1951	No.	8	7	4	2
		$\bar{X}$ length	8.6	12.6	15.9	17.1
	1959	No.	32	23	13	2
		$\bar{X}$ length	7.3	12.4	17.5	18.2
Brook	1959	No.	2	2		
		$\bar{X}$ length	6.3	9.2		

Kolar's Reservoir No. 2

Considerable difficulty was encountered rehabilitating Kolar's Reservoir No. 2 in the fall of 1959 due to the complex of ditches and sloughs upstream from the reservoir. It was concluded a complete kill was achieved following a two week gill net set which caught no fish.

However, one net set in February 1961, caught 39 suckers and 8 trout. It is thought the majority of the suckers came in from the net-work of ditches and sloughs through which water is diverted to fill the reservoir in the spring.

The trout growth is poor compared to that in other farm reservoirs following rehabilitation. This is probably due to competition with suckers. This project is considered unsuccessful.

RECOMMENDATIONS:

It is recommended that this investigation be continued as intensively as time will permit to gain needed information on growth rate of trout as it is related to stocking rates in rehabilitated reservoirs.

DATA AND REPORTS:

The original data and reports are in the fisheries office of the District Headquarters in Great Falls, Montana.

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Date: April 24, 1961

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECT

STATE OF: Montana

PROJECT NO: F-5-R-10 NAME: Central Montana Fishery Study

JOB NO: IV TITLE: Investigation of Fish Age and Growth and Food Abundance in Tiber Reservoir and the River Below

PERIOD COVERED: May 1, 1960 to April 30, 1961

ABSTRACT:

The fish population was sampled at three stations in Tiber Reservoir during June and September, 1960. There were 980 rainbow trout (26%) and suckers (74%) taken in 28 gill net sets. Trout growth was relatively poor: 8.6, 11.8, 12.7 and 14.6 were the Calculated lengths at annuli II, III, IV and V respectively. The trout diet consists primarily of plankton with midge larvae and fish occurring to some extent. The occurrence of forage fish in the diet was mainly restricted to trout 14 inches total length and longer. A higher condition factor was shown by trout using forage fish for food. Midge larvae were the only bottom organisms of any consequence in the reservoir, and they were relatively scarce, averaging one organism per three Ekman dredge samples in June and one per one dredge sample in September.

For the most part the quality of the water and quality and quanity of fish-food in the river below the dam was found to be much improved over the river above. An exception to this trend was a three to five mile section of river immediately downstream from the dam which supported a somewhat different population of bottom fauna and periphyton. Little difference was noted in trout growth and condition between the reservoir and the river below. However, conclusions were not drawn on growth in one river due to insufficient information on Migrations. Stomach contents of trout taken at the various stations in the river corresponded well with fish-food taken in bottom samples.

OBJECTIVES:

The objective of this study is to determine the status of the trout fishery and fish-food in Tiber Reservoir and the Marias River below Tiber Dam.

TECHNIQUES USED:

Fish samples were collected in the reservoir with 125-foot graduated mesh gill nets and in the river with dynamite and hook and line. Scale samples were sent to the Fish and Game Laboratory, Montana State College, for age and growth determinations.

Bottom fauna samples were taken in the reservoir with a 36-square-inch Ekman dredge and in the river with a square yard sampler. They were analyzed by numbers and volume of the various groups of fish-food organisms present. Three square yard bottom samples were collected at each station in the river during June and August. They were analyzed by number and volume.

Stomachs were preserved on 166 trout and 76 suckers from the reservoir and analyzed for per cent occurrence of the various groups of fish-food organisms present.

Water chemistry determinations were made by the State Board of Health.

FINDINGS:

Tiber Reservoir

Description

The reservoir covers an area of approximately 15,000 acres 70 per cent of the time. The level fluctuated 12 feet in 1958, 18 feet in 1959 and 10 feet in 1960. The operational plan now is to increase this fluctuation by one foot each year. Since the water in Tiber is not used for irrigation or power and the main use has been recreation, it would seem a constant level could be maintained. According to the Bureau of Reclamation, these fluctuations stem from concern over the settling of the spillway works.

Nearly 10,000,000 fingerling rainbow trout were planted in the new impoundment over a span of three years, 1956-1958. These fish did well the first two years and excellent fishing prevailed. Their diet consisted primarily of snails which in turn were thriving on the acres of inundated terrestrial vegetation. When the terrestrial vegetation had decomposed the snail population declined along with the condition and growth of the trout.

The sedimentation in Tiber is considerable due to an incoming load from the river and eroding banks in the impoundment proper. It undoubtedly has a serious effect on the bottom

fauna and plankton production. In regard to reservoir studies in Oklahoma, Irwin (1959) stated, "The increased turbidity and siltation on the bottom decreased photosenthetic activity of algae and smothered bottom organisms so that only a few could be found. The adult fish lived and thrived quite well feeding on smaller fish but the freshly-hatched spawn of these species apparently had no food on which to feed until they could grow large enough to feed on other fish." These findings are consistent with the conditions in Tiber.

Fish and fish-food were sampled at three stations in the reservoir during June and September. The location of the stations is shown in Figure 1. These stations are designated: Dam, Willow Creek Arm and Turner Park.

Fish-Food

The bottom fauna were sampled during June and September at the three sampling stations shown in Table 1. Between 10 and 15 dredge samples were taken at each location at depths ranging from 6 to 40 feet. Midges were dominant and practically the only organism of consequence found. In June an average of 1 midge larva per 3 dredge samples was found and in September 1 midge per dredge sample. The number of midges was slightly more in the Willow Creek Arm but probably not significantly more. Only 4 dragonfly naiads were collected.

Zooplankton did not appear to be numerous, however, the sampling in the reservoir was not sufficient enough to arrive at any estimates of relative abundance. Very few plankters were taken in weekly samples in the river below the dam which would indicate their lack of abundance in the reservoir.

Forage fish are numerous in shallow bays, however, due to the trough-like shape of the reservoir, shallow areas comprise a small percentage of the total area. Attempts will be made in 1961 to get better estimates of the relative abundance of forage fish.

It has been found that the factors governing plant growth and distribution are the factors having the greatest influence on lake productivity (Roelofs, 1944). For the most part factors such as location, position, size, and shape of the lake basin are not favorable in Tiber Reservoir. The wind action in Tiber erodes the banks, washing in silt and covering up any organic matter which has settled out and which is necessary for aquatic plant establishment. The euphotic zone is minimal due to the steep shoal areas. All these factors preclude the establishment of aquatic plants.

Fish Diet

The diet of the trout (Figure 2) consisted mainly of tendipedid larvae and cladocera, with cladocera occurring most frequently (81%). The sucker diet (Figure 3) was nearly the same except that ostracoda occurred along with cladocera and much of their diet was made up of unidentifiable detritus from the bottom muds.

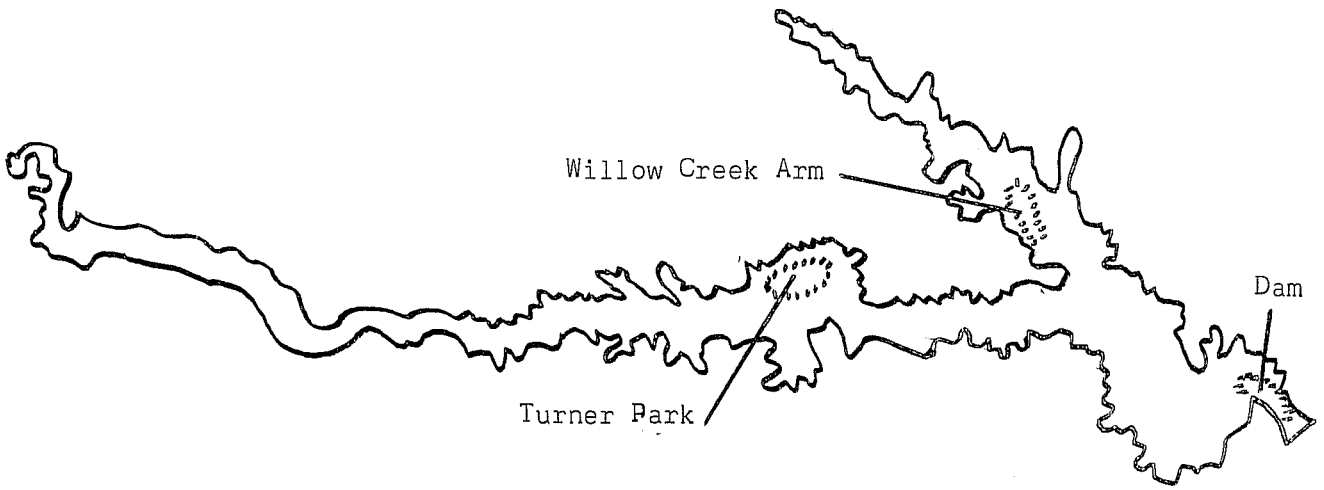

Figure I. The location of the three sampling stations in Tiber Reservoir during the summer of 1960.

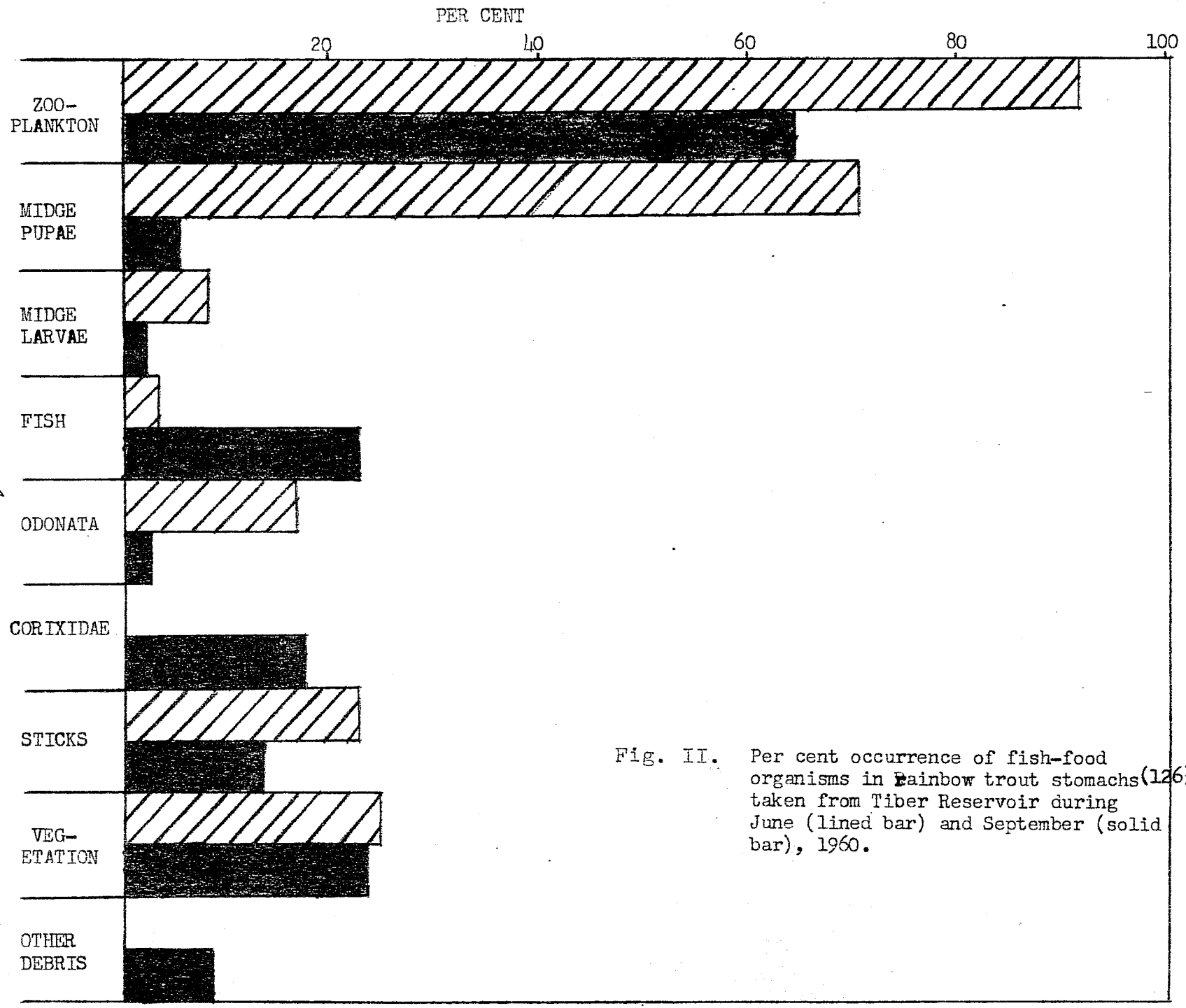

Fig. II. Per cent occurrence of fish-food organisms in Rainbow trout stomachs taken from Tiber Reservoir during June (lined bar) and September (solid bar), 1960.

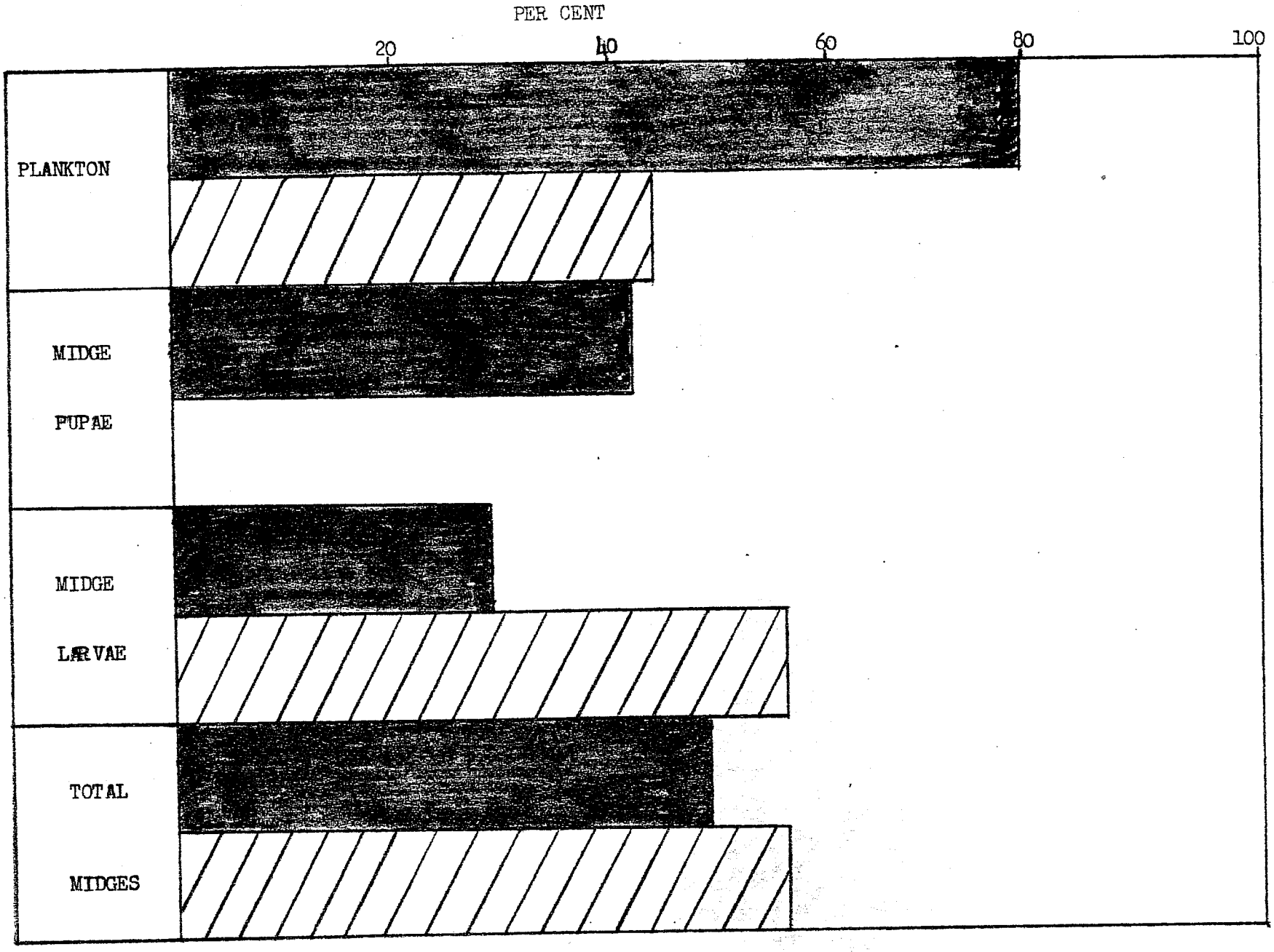

Fig. III. Per cent occurrence of fish-food organisms in sucker stomachs taken from Tiber Reservoir during June(solid bar) and September (lined bar), 1960.

The occurrence of forage fish in the trout diet increased somewhat in the fall sample as compared to the spring sample (Figure 2). Forage fish occurred frequently in the stomachs of fish 14 inches in length and larger (Figure 4). The same situation has been found by other investigators; Boyd (1950) and Crossman and Larkin (1959). The trout which were eating other fish were in much better condition than those which were not.

The future of the fishery in Tiber Reservoir seems to depend, in part, on two factors; (1) the extent of aquatic plant growth and distribution and (2) the extent to which trout use other fish in their diet. Investigations by Sheilds on Fort Randall (1954) and Gavins Point (1957) Reservoirs in South Dakota indicates that aquatic plants (Potamegeton) will establish, as they have to some extent in Tiber, but spreading is unlikely due to excessive wave action, drawdown and sedimentation. Potamegeton pectinatus is the only emergent plant found in Tiber, probably due to its thin leaves being somewhat unaffected by the excessive sedimentation (Hynes, 1960). In Fort Randall, forage fish were found to increase in abundance in the fourth year of impoundment (Shields, 1956). In Paul Lake, British Columbia, Crossman and Larkin (1959) found that it took several years for trout to "learn" to take the redside shiner for food during which time shiners were abundant.

Fish

Fish present in Tiber Reservoir include white suckers (C Su), longnose suckers (F Su), carp, ling, rainbow trout (Rb) and at least one forage species (Nstropis sp). A total of 28 gill net sets were made in the reservoir during June and September. In these 980 fish were caught. Suckers comprised 74 per cent of the total catch and trout 26 per cent. Only 2 small carp were caught. Trout were caught faster at the Turner Park Station than the other two (Table 1).

Table 1. Rainbow Trout Sampling at Three Locations in Tiber Reservoir During June and September, 1960

Station	Turner Park	Dam	Willow Creek Arm
Catch	64	115	81
% Composition	34%	27%	22%
Rate (No./Net-Hr.)	2.03	1.60	1.30

The growth of the trout further demonstrates the scarcity of fish-food in the reservoir. The average calculated lengths at annuli II, III, IV and V for all stations were 8.6, 11.8, 12.7 and 14.6 (Table 2) which is relatively slow when compared to other new or rehabilitated prairie reservoirs. There was a decided increase in growth rate in the 1958 year class of trout over the 1957 class. A satisfactory explanation for this cannot be given. A sample of fish taken in 1958 showed

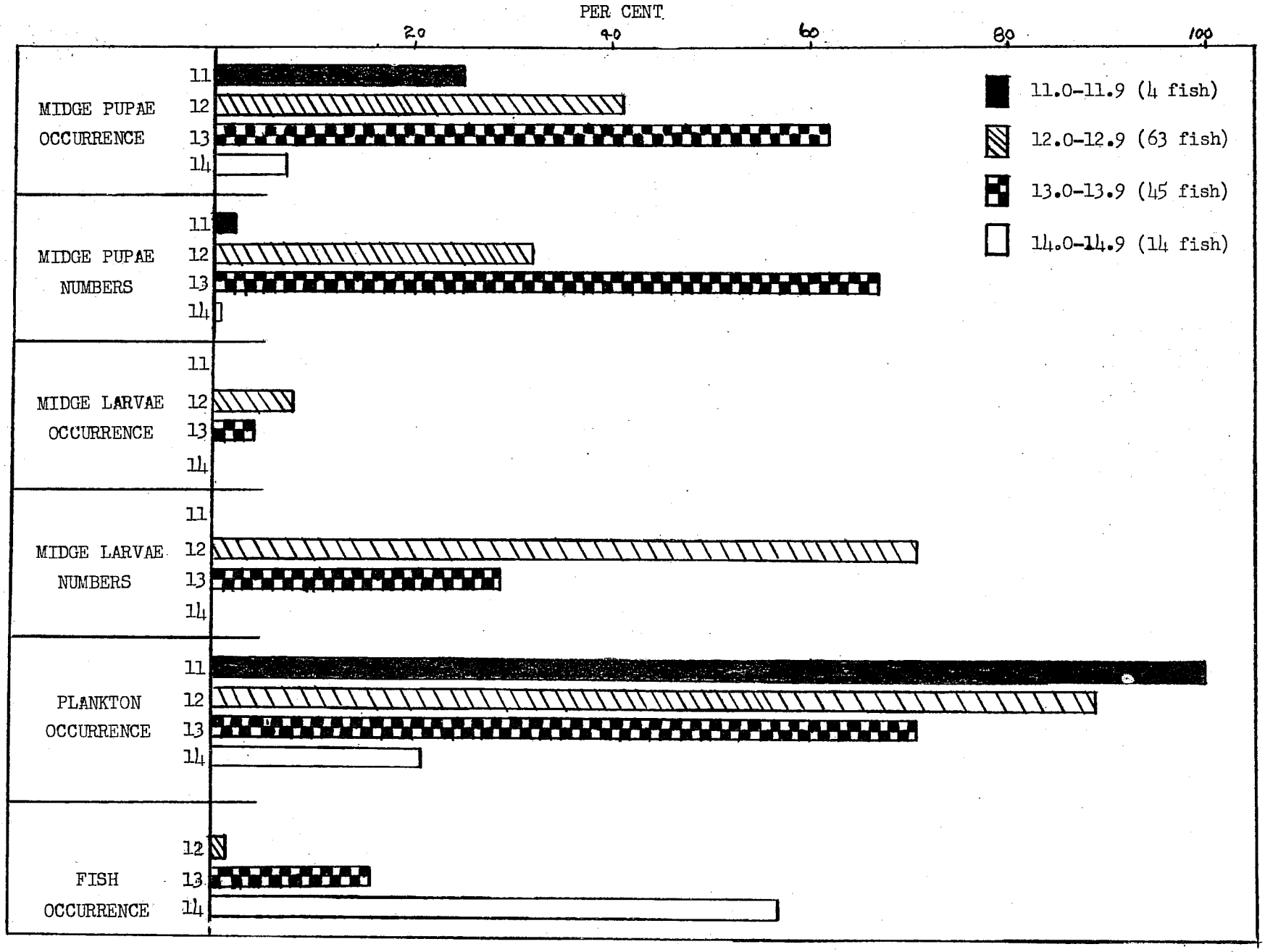

Fig. IV. Per cent occurrence of fish-food organisms and per cent number of midges found in the diet of rainbow trout, separated into four size groups, taken from Tiber Reservoir during June and September, 1960.

the 1956 year class to also be slower than the 1958. The opposite trend would be expected since fishing and the condition of the fish was apparently best during the first two years following the initial plant.

Trout growth was faster at the Willow Creek Arm station than the other two stations (Table 2). The Dam station showed the slowest trout growth and the fastest sucker growth (Table 3). This correlated with the condition of the trout at the three stations. The mean condition factor of the Willow Creek Arm fish was 33 in June and 35 in September, whereas, it was 31 for both the June and September samples at the other two stations (Table 4). The better growth and condition of the trout in the Willow Creek Arm can probably be attributed to the larger percentage of littoral zone in that area of the reservoir.

The growth of the white sucker is considered good in comparison to other impoundments in this area. Tiber shows a somewhat faster sucker growth than Canyon Ferry Reservoir which is a year older (Heaton, 1959). A sample of suckers taken from Tiber in 1958 consisted of two year classes; 1956 and 1957. The 1960 sample consisted of only three year classes; 1957, 1958 and 1959 (Table 3). It is understandable that only two year classes were abundant in 1958, since an entire watershed rehabilitation project was completed in 1955. If any fish of the 1956 year class remained in 1960 it seems unlikely that none would have been collected in a sample of 280 scales. Another year of sampling would be desirable before any conclusions are made regarding the apparent longevity of the suckers.

Table 2. Mean Calculated Total Length in Inches of Rainbow Trout Collected from Tiber Reservoir During 1960

Year Class	Age Group	No. of Fish	Year of Life 2	3	4	5
		Turner Park				
1958	II	44	8.9	11.9		
1957	III	16	8.1	11.3	12.7	
1956	IV	1	9.3	12.7	14.0	15.0
Total		61	8.7	11.8	12.8	15.0
		Dam				
1958	II	69	8.6	11.9		
1957	III	34	8.0	11.2	11.4	
1956	IV	1	7.8	10.2	11.4	12.4
Total		104	8.4	11.7	12.4	12.4
		Willow Creek Arm				
1958	II	51	9.3	12.0		
1957	III	16	7.6	11.7	13.1	
1956	IV	1	8.5	13.6	15.5	16.4
Total		68	8.9	12.0	13.2	16.4
All Stations		233	8.6	11.8	12.7	14.6

Table 3. Mean Calculated Total Length in Inches of White Suckers Collected from Tiber Reservoir During 1960

Year Class	Age Group	No. of Fish	Year of Life 1	2	3
		Turner Park			
1959	I	2	3.7		
1958	II	51	2.9	8.2	
1957	III	19	2.3	6.9	9.1
Total		72	2.8	7.9	9.1
		Dam			
1959	I	13	3.5		
1958	II	51	3.0	9.0	
1957	III	10	2.6	8.9	11.8
Total		74	3.0	9.0	11.8
		Willow Creek Arm			
1959	I	19	4.1		
1958	II	102	2.6	8.5	
1957	III	13	2.4	8.0	11.4
Total		134	2.8	8.4	11.4
All stations		280	2.9	8.4	10.5

The first check on the trout scales was undoubtedly a planting check so is not considered in the growth analysis. A few fish had two checks close together at the focus and were assumed to be late summer plants. There were 10 trout from the dam station in this category. They were excluded from the mean length calculation at annulus II.

Table 4. Mean Length (Inches), Weight (Pounds) and Condition Factor of Trout Collected at Three Stations in Tiber Reservoir During June and September, 1960

	June			September		
	$\bar{X}$ Length	$\bar{X}$ Weight	$\bar{X}$ C	$\bar{X}$ Length	$\bar{X}$ Weight	$\bar{X}$ C
Dam	12.8	.65	31	13.1	.69	31
Turner Park	12.7	.63	31	13.3	.73	31
Willow Creek Arm	12.8	.69	33	13.4	.84	35

Marias River

Description

The flow in the Marias River below Tiber Dam varied from 1485 to 145 cfs during 1960. Despite this fluctuation only a small

percentage of the stream channel was dry during low flow. Tiber Dam creates conditions in the river below which are considerably more desirable for trout production than in the river above the reservoir. Some of these conditions are: more constant temperatures, decreased sedimentation and for the most part a greater abundance of trout-food-organisms. A more detailed study of the effect of the dam on the river is being carried out under Job V as a masters thesis.

Figure 5 shows the locations of the sampling stations in the river above and below the reservoir.

Fish-Food

A considerable variation in the abundance and species composition was found in the bottom fauna of the Marias River above and below Tiber Dam. Sampling indicated the standing crop of bottom fauna to be greater in the section of river below the dam than above (Figure 6). This was probably due to the decreased sedimentation below.

The species composition was quite different in the first three to five miles below the dam than in any other section of the river. The more sensitive organisms, such as stoneflies, were absent, but it was the only place where black fly larvae were found. Figures 7 and 8 illustrate the percentage composition of the various groups of organisms in the samples taken at the nine river stations. Associated with this change in bottom fauna is a change in the algal community. There is an abundance of filamentous green algae (primarily Cladophora sp.) below the dam which subsides in the vicinity of the bottom fauna change. A definite explanation for this rapid change in the bottom fauna and algae populations within a relatively short distance below the dam cannot be given. The problem has been considered from several aspects, the primary one being water quality.

There does not seem to be any deleterious substances in the formations around the fill area. It is composed of mainly Colorado shale, which leaches out sulfates and calcium for the most part. According to Erdman* (personal communication) there are no toxic substances in these layers. Total dissolved solids below the dam were as high as 26,340 ppm in 1956, due to leaching in the fill area, but have decreased since that time. Table 5 summarizes the water analysis to date on the river. The differences exhibited in concentrations of the various properties between stations are not significant, however, luxurient algae growths (commonly Cladophora sp.) have been known to be produced by only slight changes in the concentrations of certain nutrients (Hynes, 1960). There is probably a serious smoothering effect exhibited by the thick growths of algae on the bottom fauna. This possibly explains the difference in species composition in bottom fauna immediately below the dam compared to bottom fauna in sections downstream.

* Dr. A. T. Erdman, U. S. Geological Survey Office, Great Falls, Montana.

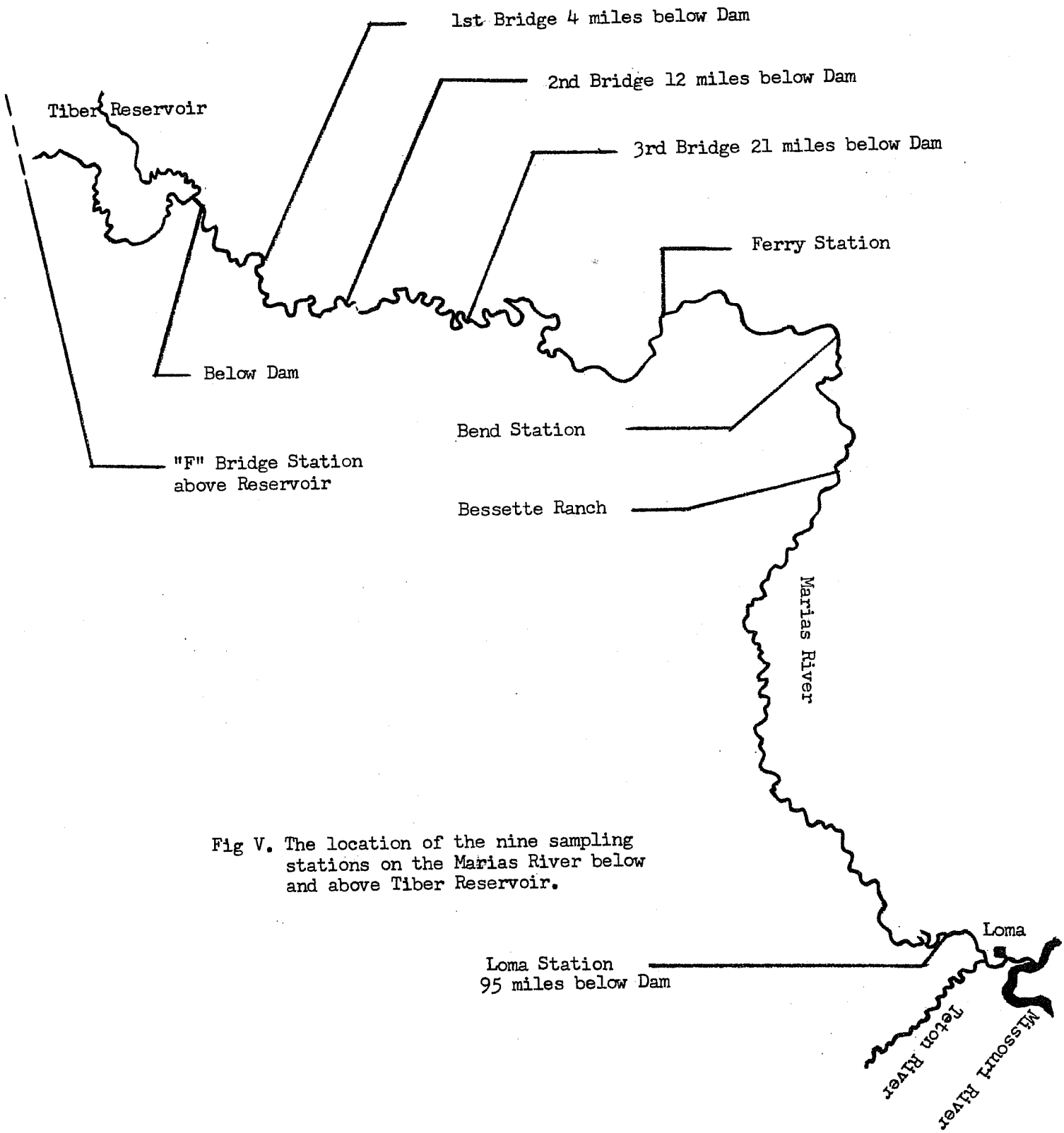

Fig V. The location of the nine sampling stations on the Marias River below and above Tiber Reservoir.

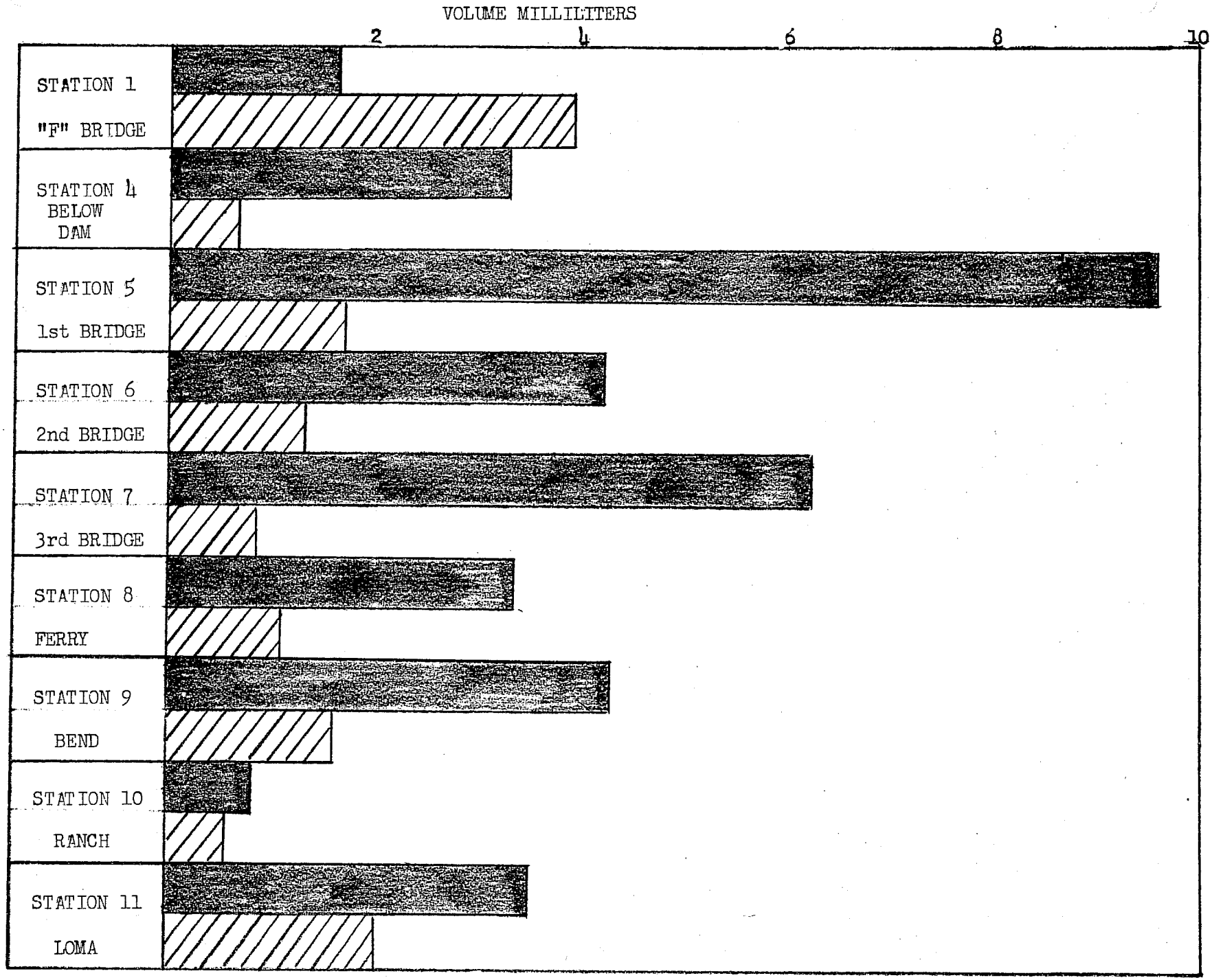

Fig VI. Standing crop of bottom fauna (volume) sampled at each station in the Marias River during June (solid bar) and August (lined bar), 1960.

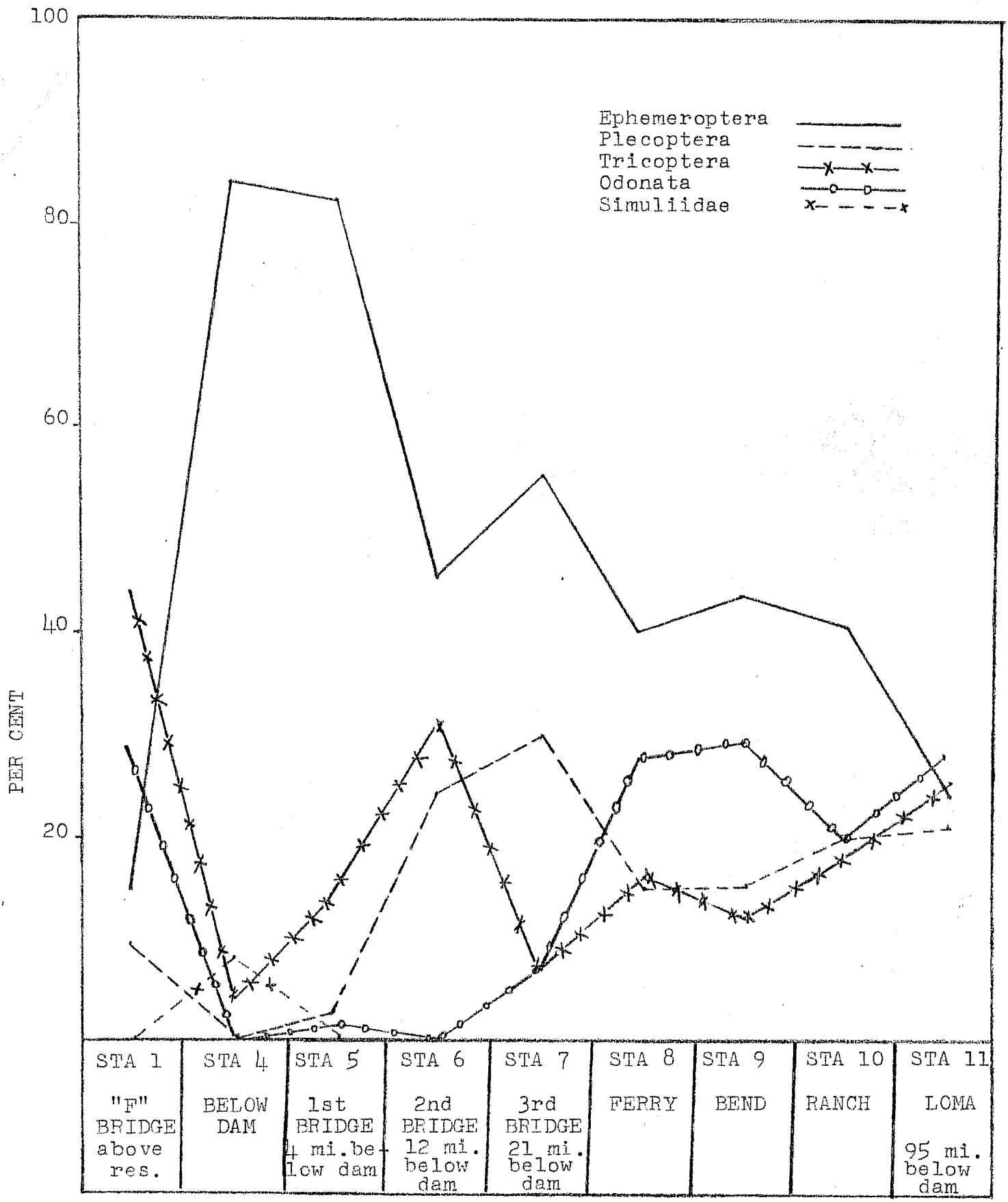

Fig. VII Per cent composition, by volume, of the various groups of organisms sampled at each station in the Marias River during June and August (averaged together), 1960.

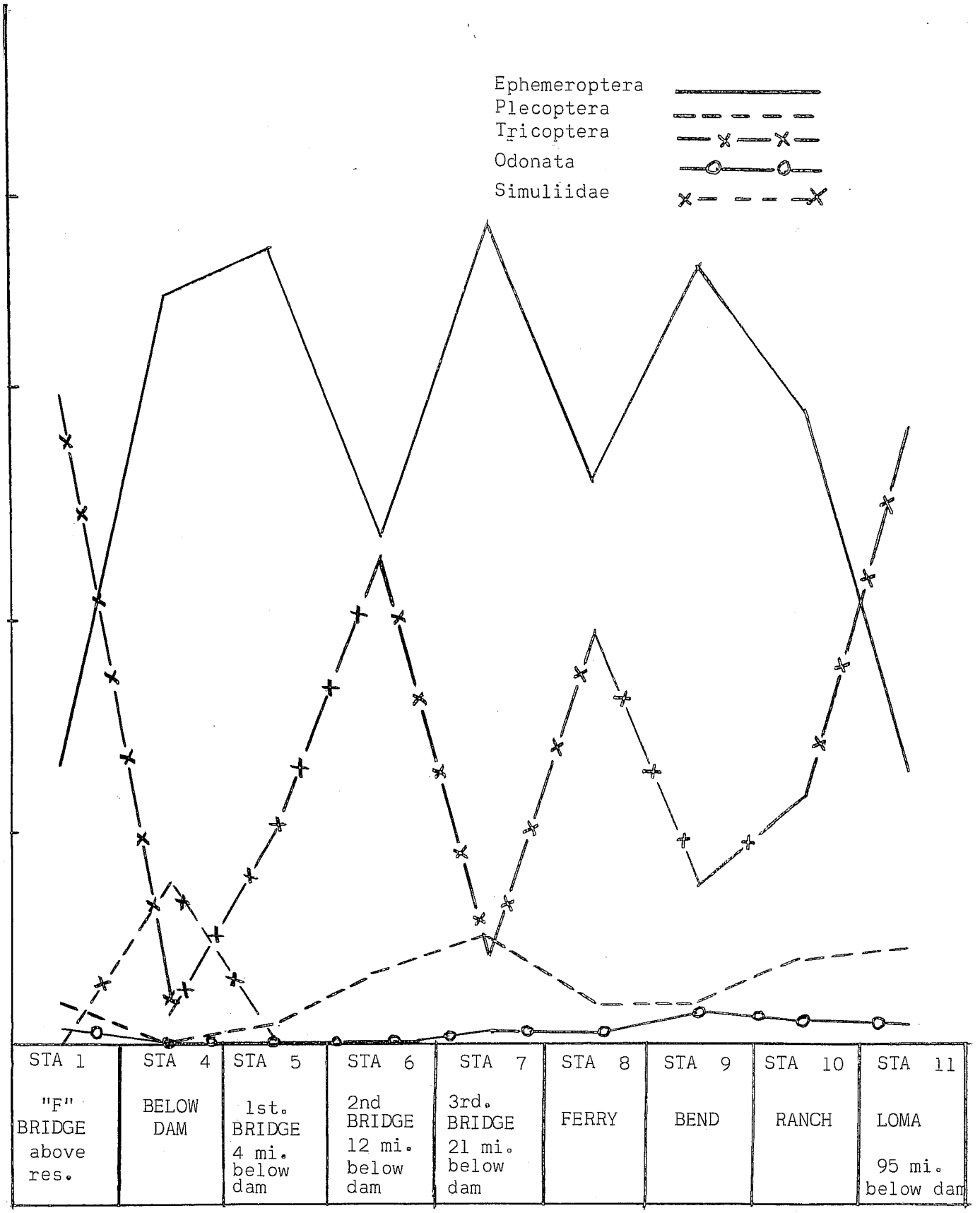

Fig. VIII. Percent composition, by number, of the various groups of organisms sampled at each station in the Marias River during June and August (averaged together), 1960.

Table 5. Water Quality Data Collected from the Marias River Since the Construction of Tiber Dam. Concentrations are Expressed in ppm

Station	Date	PO_4	TDS	Hard	Ca	Mg	Na & K	CO_3	HCO_3	SO_4	NO_3	Cl
Below dam	10/22/56		26,340		684	765	5,294	0	1,360	12,336	1,947	241
Above res.	8/16/60	0.0	364								0.2	
Below dam	8/16/60	0.3	351								0.5	
Loma	8/16/60	0.1	349								<0.1	
Above res.	2/16/61	0.2	540	300	62	35	30	0	195	189	2.5	3
Below dam	2/16/61	0.26	550	320	64	39	30	0	189	193	1.8	2
6 mi. below dam	2/16/61	0.20	540	310	64	37	32	0	201	202	1.7	2
20 mi. below dam	2/16/61	<0.05	520	320	66	38	32	0	195	214	2.0	2

Fish

Fish collected in the river below were similar in size and condition to those from the reservoir, however, it is not possible to make any conclusions regarding fish growth and abundance due to our inability to sample the river effectively and the lack of information regarding migration.

The diet of the trout changed as the bottom fauna changed in progressing downstream. The trout (25) diet at station four below the dam consisted of large globs of filamentous algae, probably taken because of the blackfly larvae which clung to it. At station five downstream, larger mayflies and a few small stoneflies were found in the trout (34) stomachs. The bottom fauna sampling showed this same trend in percentage composition of the fish-food progressing downstream from the dam (Figure 6). Station seven only produced 1 trout but it was full of larger stoneflies.

RECOMMENDATIONS:

1. The trend in growth, condition, diet and abundance of the trout in the reservoir should be followed for at least one more year.

2. An estimate of relative abundance of forage fish would also be desirable.

3. Further investigations into the fish population of the Marias River below the reservoir is necessary to determine the extent of the sauger and goldeye migrations.

4. It is felt that the river from the dam downstream to the mouth holds more promise as a long range fishery (trout and/or sauger) than the reservoir.

5. More information is necessary before an effective step forward can be taken in management of the fisheries of the lower Marias and Tiber Reservoir.

SUMMARY:

1. The morphometry of the reservoir basin is such that a very small percentage of the 15,000 surface acreage is littoral zone and that is continuously silted in by wave action on the steep, erosive banks, precluding the production of bottom fauna and aquatic plants.

2. There was a scarcity of bottom fauna in the reservoir. Midge larva was the most common organism found in the samples.

3. The diet of the trout consisted primarily of plankton. There was some occurrence of midge pupae and larvae and forage fish, however. The occurrence of fish in the trout stomachs was most frequent in the fall.

4. The sucker diet consisted of the same food items found in trout with the exclusion of fish and addition of unidentifiable detritus and organic matter from the bottom mud.

5. Trout growth was slow, particularly during their third year in the reservoir when they gained only .9 inches in length. There was an apparent increase in growth rate of the trout in the 1958 year class over the 1956 and 1957 year classes. This was associated with a decrease in growth rate of common suckers from 1956-1959. However, sucker growth is good compared to their growth in Canyon Ferry Reservoir.

6. Trout that were using forage fish for food showed a better condition factor and rate of growth than those that were not using fish.

7. The condition and growth of trout from the river below the dam showed little difference from those taken in the reservoir. How long the fish had been in the river is not known, however.

8. In general, fish-food conditions in the river below the dam were much improved over the river above the reservoir. The 3-5 mile section directly below the dam is an exception, however. In this section the production of desirable fish-food is being inhibited, probably by the physical effect (smoothering and abrasion) of dense growths of green algae (Cladophora sp.).

DATA AND REPORTS:

The orginal data and reports are filed in the fisheries office of the District Headquarters in Great Falls.

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MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECTS

State of Montana

Name: Central Montana Fishery Study

Project No. F-5-R-10

Title: A Partial Limnological Investigation of Tiber Reservoir and the River Below

Job No. V

Period Covered: May 1, 1960 to April 30, 1961

ABSTRACT:

Physical, chemical and biological data were collected on Tiber Reservoir and the Marias River below during the summer of 1960. Stratification of the reservoir was found beginning in July, becoming most pronounced throughout August and disappearing by September 8. Maximum-minimum temperatures taken immediately below the reservoir tended to indicate less fluctuation of water temperature than was measured at stations farther down the river. Turbidity samples collected above the reservoir averaged higher than those below. Turbidity of the reservoir was greater in June than in August. Qualitative and quantitative analysis of plankton samples are being carried out at Montana State College.

OBJECTIVES:

The objectives of this study are to determine the effect of Tiber Reservoir on the Marias River from below Tiber dam to its confluence with the Missouri River.

TECHNIQUES USED:

Collection of data involved the period beginning June 1 and ending September 24, 1960.

Reservoir:

Three stations were established on the reservoir at which data were collected. The first station was about one-half mile above the dam, the second located in the main reservoir was at Turner Park, and the third located in a large arm of the reservoir known as Willow Creek Arm. Vertical temperatures were taken with an electrical resistance thermometer. Turbidity samples were collected at 10 foot intervals from surface to bottom with a Kemmerer water sampler and placed in dark bottles. Three turbidity transects were run from the river above the reservoir to the dam covering the entire length of the reservoir (approximately 32.5 miles).

Samples were taken at approximately 2.5 mile intervals. Turbidities were read on a Hellige Turbidimeter. Secchi disc measurements of light penetration were taken.

Plankton samples were collected following measurement of a vertical series of temperatures at each of the three stations. A minimum number of samples were taken as described by (Welch 1948 pp.273-274) for temperate lakes of the first and second orders. Samples were collected by means of the pump and hose method (Welch 1948 pp. 231-232). One-hundred liters of water were run through a No. 20 plankton net and the concentrate was preserved in 4-5 percent formalin.

River:

Nine stations were established in the river. One station was approximately 13 miles above the reservoir and the remaining eight stations below the dam were at various points of access covering about 82 miles of river.

One Dickson Minicorder thermograph was used at the station above the reservoir and another was used at the station immediately below. Maximum-minimum thermometers were used to record temperatures at the other 7 stations in the river.. Temperatures were read at weekly intervals.

Turbidity samples were collected at each station each week and read on a Hellige turbidimeter.

Plankton samples were collected at each station by passing 100 liters of water through a No. 20 plankton net. The concentrated sample was preserved in a 4-5 percent formalin.

Periphyton samples were collected by submerging two 4 dm^2 plexiglass slides in the river at each station for two week intervals. The chlorophyll pigment extraction method of measuring organic production (modified from Harvey, 1934) was followed.

Limited chemical analysis was made to determine alkalinities. Dissolved oxygen was determined by the Winkler method.

Total dissolved solids (TDS), nitrate and phosphate samples were collected. Analysis was done by the Water Pollution Branch, State Board of Public Health.

Velocity and discharge of the river was measured at each station using a Gurley Current Meter.

FINDINGS:

Vertical temperatures taken on the reservoir July 8, indicated that the reservoir was beginning to stratify. By August 11 and 12 a thermocline was well established and was still prominent August 18. On September 8 the vertical temperature was measured and it was found that the temperature of the reservoir had dropped at least 8 degrees and the water was nearly the same temperature throughout.

Temperatures taken using the two recording thermographs are of no value because it was found that the instruments became influenced by extremely high and low air temperatures and showed no correlation with temperatures indicated by a maximum-minimum thermometer placed in the water during the same period.

Maximum-minimum temperatures taken below the reservoir showed a smaller range between average maximum and minimum in the immediate downstream vicinity from the day (approximately one mile). Although this is concluded from only 3 weeks of temperature information for the station immediately below the dam, it suggests that the reservoir has the effect of holding water temperature fluctuations to a minimum. No temperature data was obtained in the river above the reservoir due to failure of the thermographs. Therefore, no comparison of the reservoir's effect on the temperature of the river can be made without collection of further data.

Turbidity samples collected on the Marias River each week from June 14 to September 22, indicated on the average higher turbidities above the reservoir (16.62 ppm) than below (ranging from 2.50 ppm immediately below the dam to 8.79 ppm approximately 82 miles down river).

Turbidity samples taken on the reservoir during the first transect made on June 23 showed higher average turbidity (37.3 ppm) for the reservoir than did the transects run July 21 and August 30 which showed average turbidities of 9.7 ppm and 12.3 ppm, respectively. A limited number of turbidity samples taken throughout the summer from Willow Creek Arm of the reservoir showed slightly higher turbidities when compared to samples from the main reservoir.

Secchi disc readings were taken during the June and July turbidity transects. The average secchi disc reading for June 23 was 0.62 meters and that for July 21 was 1.65 meters. Average secchi disc readings were found to be lower in the Willow Creek Arm (1.72 meters) as compared to the main reservoir (2.96 meters).

No significant difference was found in alkalinities measured above and below the reservoir. Average TDS measured above, below and in the reservoir was 368 ppm. No substantial difference was found between samples taken above and those taken below. Nitrate and phosphate samples also indicated little or no change.

Dissolved oxygen was determined on the outlet water which was being drawn from the bottom of the reservoir on August 2 and was found to be 8.95 ppm. On August 18, water was sampled at a depth of 130 feet in the reservoir, one-half mile above the dam, and was found to contain 11.5 ppm dissolved oxygen. On the same date the station at Turner Park was sampled at a depth of 65 feet and 8.3 ppm dissolved oxygen was found.

The velocity and discharge of the river were measured at every station on June 30, July 27 and August 30 to see if there may be some correlation between the rate of discharge and the amount of lake plankton found at various distances below the reservoir.

The plankton samples are being analyzed at Montana State College and as yet no processed data is available.

No particular significance can be attached to the periphyton data collected at each station in the river. Difficulty was had in collecting samples below the reservoir due to large amounts of filamentous algae floating down the river and rubbing the periphyton growth off the slides. More work is required to devise a type of shield that will prevent this and still allow the maximum amount of light to strike the slides.

RECOMMENDATIONS:

Another summer of work is required before recommendations can be made.

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Prepared by: Quentin J. Stober

Date: April 30, 1961

Approved by: _____
George D. Holton
Asst. Coordinator

MONTANA FISH AND GAME DEPARTMENT
FISHERIES DIVISION
HELENA, MONTANA

JOB COMPLETION REPORT
INVESTIGATIONS PROJECT

STATE OF: Montana

PROJECT NO: F-28-R-1 NAME: Sun River Fisheries Study

JOB NO: I TITLE: Inventory of Waters of the Sun River Drainage Upstream from Diversion Dam

PERIOD COVERED: May 1, 1960 to April 30, 1961

ABSTRACT:

Twenty-six streams and two mountain lakes were in the surveyed Sun River drainage during the summer of 1960. Stream flows, bottom samples and water quality data were collected on each stream. Fish populations present were sampled by shocking, pole and line and dynamite. An experimental plant of cutthroat trout was made in Rock Creek, a stream previously uninhabited by fish.

OBJECTIVES:

To determine the physical, chemical and biological characteristics of the waters of the Sun River drainage and obtain estimates of existing or potential fisherman use. This information will be used in forming a fish management plan for this area.

STREAM SURVEY:

Techniques Used:

Twenty-six streams of the Sun River drainage were surveyed during the summer of 1960. One to six sections were sampled on each stream. Fish populations were sampled by electrofishing, pole and line and dynamite. Water samples were collected and analyzed at the State Board of Health Laboratory. Two square-foot bottom samples were collected at each station. Stream flow data were taken with the floating chip method.

Field data and other information collected on this project have been transferred to permanent file cards.

Findings:

The data obtained from these surveys is presented in Tables 1 and 2. Total dissolved solids ranged from 1 ppm at the headwaters of Rock Creek to 275 ppm at Circle Creek. It is generally considered that productivity is low in waters with less than 100 ppm total dissolved solids. A fair amount of desirable fish-food organisms were found at each station.

It is believed that before settlement by white men, the Sun River drainage above the falls, near the present Diversion Dam, was uninhabited by fish. At the time of this survey most of the streams studied contained trout. These apparently are descendents of hatchery fish planted from time to time. The trout found were generally small due to the comparatively low fertility, low water temperature, and short growing season.

Four of the streams were uninhabited by fish due to barriers near their mouths which prevented movement upstream. One of these streams (Rock Creek) was planted with 20,000 cutthroat trout on September 9, 1960.

Two 125-foot graduated nylon mesh gill nets were set in Renshaw Lake. Since no fish were captured it was assumed that the lake was uninhabited by fish. In July 1960 it was planted with 500 golden trout.

Bear Lake was found to have a good population of Yellowstone strain cutthroat trout. Fish populations were sampled by pole and line. Scale samples taken from fish collected will be used for age-growth determinations.

Table 1. Data collected at stream mouths in survey of the Sun River Drainage, Teton and Lewis and Clark Counties, Montana, 1960

Stream	Date	Volume of flow	Turbidity	PH	Total dissolved solids
Fairview Creek	6/30/60	23	1.2	8.1	140
Wood Creek	6/29/60	24	.55	8.1	185
Ford Creek	7/ 1/60	21	.21	7.8	180
Ahorn Creek	7/28/60	24	.35	7.9	76
Circle Creek	7/ 8/60		.55	8.1	275
Baldy Bear Creek	7/24/60	4	.43	8.0	37
Bear Creek	6/22/60	19	1.8	7.9	110
Biggs Creek	7/ 7/60	60	.35	8.0	185
Cabin Creek	7/ 9/60		3.6	8.0	265
Gates Creek	7/21/60	3.3	.24	7.9	113
Glenn Creek	7/19/60	19	1.5	8.1	95
Headquarters Creek	10/ 6/60	6			180
Hoadley Creek	8/12/60	9			140
Indian Creek	7/28/60	3	.35	7.5	91
Lick Creek	10/ 5/60	10	.22	8.1	150
Moose Creek	7/19/60	48	3.5	8.1	107
No. Fk. Sun River	8/19/60	172	.30	8.1	133
Open Creek	10/ 5/60	12	.30	8.1	95
Ray Creek	10/ 6/60	10	.32	8.1	170
Red Shale Creek	7/22/60	26	.43	8.1	126
Rock Creek	8/17/60	33	.17	7.8	94
Route Creek	10/ 6/60	20	.16	8.0	140
So. Fk. Sun River	8/12/60	42*	1.8	7.8	153
Straight Creek	6/29/60	151	.35	7.9	120
W. Fk. Sun River	7/28/60	91	.30	8.0	95
Wrong Creek	10/ 5/60	15	.35	8.1	130

* Stream flow taken at mouth of Hoadley Creek.

Table 2. Summary of bottom fauna sampling in the Sun River Drainage, 1960

Stream	No. Stations	$\bar{X}$ No. Sq. Ft.	Percent Composition				
			Eph.*	Ple.*	Tri.*	Col.*	Dip.
Fairview Creek	1	84	78	8	7	1	6
Wood Creek	1	45	79	16	5		
Ford Creek	1	80	62	18	18	1	1
Ahorn Creek	1	81	35	2	59		4
Circle Creek	1	33	86	6	8		
Baldy Bear Creek	1	62	72	18	5	4	1
Bear Creek	3	55	72	15	13		
Biggs Creek	2	60	38	2	60		
Cabin Creek	2	61	48	23	27	2	
Gates Creek	1	16	94				6
Glenn Creek	1	67	78	17	4		1
Headquarters Creek	1	76	34	54	12		
Hoadley Creek	1	66	53	21	16		10
Indian Creek	1	101	86	10	3		1
Lick Creek	1	75	60	27	8	4	1
Moose Creek	3	50	81	7	9	2	1
No. Fk. Sun River (lower)	4	94	74	8	15	2	1
No. Fk. Sun River (upper)	2	53	78	11	8	1	2
Open Creek	1	41	61	27	4	5	3
Ray Creek	1	43	34	48	18		
Red Shale Creek	1	57	77	2	18		3
Rock Creek	3	69	61	20	15	1	3
Route Creek	1	18	34	46	11		9
So. Fk. Sun River	4	75	69	8	19	1	3
Straight Creek	3	74	73	11	15		1
W. Fk. Sun River	3	64	80	10	8	1	1
Wrong Creek	1	87	36	53	2	9	

* Eph. = Ephemeroptera Tri. = Tricoptera Dip. = Diptera
Ple. = Plecoptera Col. = Coleoptera

Recommendations:

Approximately one-half of the more important trout waters in the upper Sun River drainage were surveyed in 1960. Approximately 20 streams and 8 lakes remain to be surveyed. This project should be continued until these surveys are completed and the project objectives are fulfilled. A follow-up survey should be made on Rock Creek to evaluate the cutthroat trout plant made in September 1960.

Data and Reports:

The original data and reports are in the fisheries office of the Montana Fish and Game Department District Headquarters at Great Falls, Montana.

Prepared by: Nels Thoreson Approved by: George D Holton

Date: June 16, 1961