MONTANA FISH AND GAME DEPARTMENT
ENVIRONMENTAL RESOURCES DIVISION

JOB PROGRESS REPORT

State Montana

Project No. FW-1-R-2 Title Smith River Drainage Inventory and Planning Investigation

Job No. I Title Planning Inventory, Fisheries

Period Covered July 1, 1969 to June 30, 1970

ABSTRACT

A field inventory of the fishery resources in the Smith River drainage was initiated to form the framework for development of immediate and long-range management plans. A step down plan was established to develop guidelines for the inventory. Trout populations and channel morphology were measured on two sections of the Smith River. Rainbow trout appear to be the most abundant trout in the main stem of the river. Fish populations were censused in 11 tributary streams. Water chemistry, water temperatures, and flow data were gathered from several streams.

BACKGROUND

Fishery resource planning has been and continues to be a phase of each fish manager's work; however, the constant pressure of day-to-day management consumes most of his time. The intensity of individual fishery problems also varies from place to place in a management area. Consequently, managers have not been able to develop complete inventories in a common area. This project will accomplish a complete fishery inventory and probably uncover problems affecting the resource. It will be a total ecological approach that has not been accomplished previously in Montana and will attempt to unify the Department's effort to solve resource management problems.

The purpose of this job will be to develop immediate and long-range fishery plans. The problem of planning will be approached from the field level beginning with the collection of basic field inventory data. Once the inventory is complete, the needs of the fishery resource determined, and the areas of land use conflicts identified, the plans for meeting fishery needs will be proposed. In order to accomplish this, a planning unit was assigned to inventory and develop plans pertaining to the Smith River Drainage in District 4.

The importance of fish and wildlife resource planning has only recently been realized. Planning activities have rapidly increased in the past ten years, but have dealt mainly with urban development and the needs and problems of the urban population. California is probably the leader in developing ground level fish and wildlife plans. Their planning efforts were initiated in 1964, and at the present time they have completed state fish and wildlife plans. Since initiation of California's planning process, other states have become interested and involved with fish and wildlife resource planning.

OBJECTIVES

The objectives of this study are to conduct and evaluate a basic planning procedure of an intensive nature. The planning procedure will be supported by basic fish and wildlife inventory data collected from the Smith River drainage. The objective of this job is to inventory and evaluate data dealing with the fishery resource within the drainage.

PROCEDURES

A single copy topographic map of the Smith River drainage was needed for convenience of the inventory. Project personnel constructed a work map by combining National Forest maps and Montana Highway Department county road maps. This piecemeal map was photographed and reproduced at a scale of one-half inch per mile.

A step-down plan was developed to serve as a guideline for the field inventory. This plan has proved a valuable guide to achieving the project objectives as the inventory advances. Following is the plan outline:

SMITH RIVER DRAINAGE INVENTORY AND PLANNING INVESTIGATION

1. To conduct and evaluate a basic planning procedure for the perpetuation of fish and wildlife populations.
    2. To conduct and evaluate a basic planning procedure for fisheries.
        3. To determine species present.
            4. To determine species distribution and abundance.
                5. To obtain information from past surveys and stocking records.
                5. To inventory waters by electrofishing, angling, netting.
            4. To determine importance and use.
                5. To determine angler days from fishing pressure survey.
                5. To conduct limited creel census.
                5. To determine economy to local area and state.
                5. To determine importance to overall state program.
        3. To determine quality and quantity of habitat.
            4. To develop standard stream classification method.
                5. To determine physical and biological properties of stream channels.
                    6. To determine cover characteristics.
                    6. To determine velocity in relation to cover.
                    6. To determine sinuosity and pool-riffle ratios.
                5. To determine and classify floodplain characteristics.

5. To classify streams by volume of flow.
5. To determine area of streams (acres or miles).
4. To classify ponds, lakes, and reservoirs.
5. To determine areas, depths.
4. To measure basic water quality.
5. To monitor chemical characteristics.
5. To monitor flow regimes and water levels.
5. To monitor water temperatures.
4. To determine detrimental programs and practices.
5. To monitor extent of dewatering and water level fluctuations.
5. To monitor extent of stream channel alterations.
6. To monitor manmade alterations.
6. To monitor alterations caused by industrial practices.
5. To determine practices altering water quality.
4. To evaluate beneficial programs and practices.
5. To determine extent and effect of Agricultural Conservation Programs.
5. To determine effects of Stream Preservation Law.
5. To determine effect of the Dredge Mining Regulation.
3. To determine access and area availability.
4. To determine land ownership.
4. To determine acceptance of recreational use of private lands.
5. To contact private landowners with reaction study.
4. To determine areas of potential development.

Trout populations were inventoried in the Smith River with the aid of electric shocking gear. The electric gear and collecting equipment was placed in a boat and fish were gathered as the boat and crew moved slowly downstream. Population estimates were made by using the Petersen-type mark-and-recapture method using Chapman's modified formula as follows:

$$N = \frac{(M+1)\ (C+1)}{(R+1)}$$

Where: N = population estimate
M = the number of fish marked
C = the number of fish in the recapture sample
R = the number of marked fish in the recapture sample (C).

Methods involved for population estimates, age structure and confidence intervals largely follow those described by Vincent (1969).

Electric shocking gear was also used to inventory fish populations in small tributary streams. The electric power source was placed on the stream bank and fish were collected from stream sections varying from 125 to 405 feet in length. All game fish captured were measured and weighed.

Limited water chemistry was conducted on streams where population inventories were conducted. Water chemistry included pH, conductivity, hardness and turbidity.

A total of 10 staff gauges were installed on streams throughout the drainage to aid in monitoring flow regimes and to help determine the quality of habitat available throughout the year. A discharge curve was constructed for each staff gauge by periodically measuring the volume of flow with a Gurley current meter. Stream gauging methods and techniques employed are described by Corbett (1962) and Wipperman (1967). Also, a water stage recorder was installed in the United States Geological Survey gage house (Eden Station) on the Smith River near the mouth of Hound Creek. The U.S.G.S. discontinued monitoring this station following the water year 1969.

Maximum-minimum thermometers were installed on some of the larger tributary streams within the drainage. The thermometers were read about once a week. A thermograph was installed on the Smith River in the U.S.G.S. gage house near the mouth of Hound Creek in the spring of 1970.

A method of measuring and describing stream morphology was initiated to determine the quality and quantity of habitat available to the fishery resource. The goal of this phase of the project is to develop a standard outline to aid the fishery worker in classifying stream habitat.

Channel morphology and physical habitat was measured in two sections of the Smith River where trout populations were estimated. The length of each section was measured down the center of the channel. Cross section data was recorded at 100 foot intervals on one section and at 200 foot intervals on the other section. Width measurements were recorded at each cross section and 9 to 10 depth readings were taken at equal intervals along a tag line. Stream bank or shoreline characteristics were subsampled by recording features within five feet on each side of the cross-section tag line.

Stream bank features were classified into one of the following four categories:

Brush.......All woody vegetation within ten feet of the shoreline. Brush was considered cover if overhanging live branches were within five feet of the water surface or if live or dead branches and roots were immediately above or beneath the water surface. Brush cover was measured horizontally along the tag line from the soil bank to the furthest extension of the vegetation over or in the water.

Grass.......Herbacious plants on immediate shoreline.

Deposition Zone.....Includes silt and gravel bars, rocks, and boulders. No vegetation within ten feet of the shoreline.

Cliff.......Parent material or bed rock within near vertical position to shoreline.

Other characteristics that further describe the physical features of the shoreline included the following:

Eroding bank.....Banks are unstable and loss of soil is evident through action of water or trampling by livestock.
Undercut.........An overhanging shelf of soil or vegetation. Only grass and bed rock banks were considered undercut. Undercut associated with brush is considered brush cover.
Debris...........Includes driftwood, snags, and logs not permanent or rooted. If presenting cover, debris is measured the same as for brush.

A landowner-recreation survey questionnaire was drawn up which is intended to determine problems and areas of conflict with private landowners and fish-wildlife-recreation related affairs. Private landowners were personally contacted with the questionnaire for the following reasons:

1. To briefly explain the objectives of this project;
2. To insure all pertinent questions on the survey form are answered;
3. To establish a personal relationship with the landowner and obtain permission to do inventory work on private property.

Results and comments from the questionnaire will not be reported until the survey is completed.

DESCRIPTION OF STUDY AREA

Findings:

The Smith River drainage lies in west central Montana, almost due south of Great Falls. Most of the western edge of the drainage is flanked by the Big Belt Mountains and the eastern boundary is flanked by the Little Belt and Castle Mountains (Figure 1). The drainage is approximately 75 miles in length and the width varies from 3 to 45 miles. The total area is slightly over 2,000 square miles. The elevation of the floor of the drainage varies from 3,350 to 5,400 feet above sea level. The highest mountain peaks range from 8,500 to 9,500 feet above sea level.

The Smith River is formed by the junction of the North and South Forks about four miles southwest of White Sulphur Springs. The North Fork drains part of the southwest slopes of the Little Belt Mountains and the northwest slopes of the Castle Mountains. The South Fork arises along the southwest flank of the Castle Mountains and from the bench lands between the Castle and Big Belt Mountains. The main stem of the Smith River then flows northwesterly through a wide valley until it enters a deep mountain gorge about 10 miles north of Fort Logan. After emerging from the canyon, the river meanders through a relatively narrow valley flanked by rolling grasslands until it joins the Missouri River near Ulm.

Numerous tributaries arise in the Big Belt and Little Belt Mountains to join the Smith River. A few of the major tributaries arising in the Big Belt Mountains

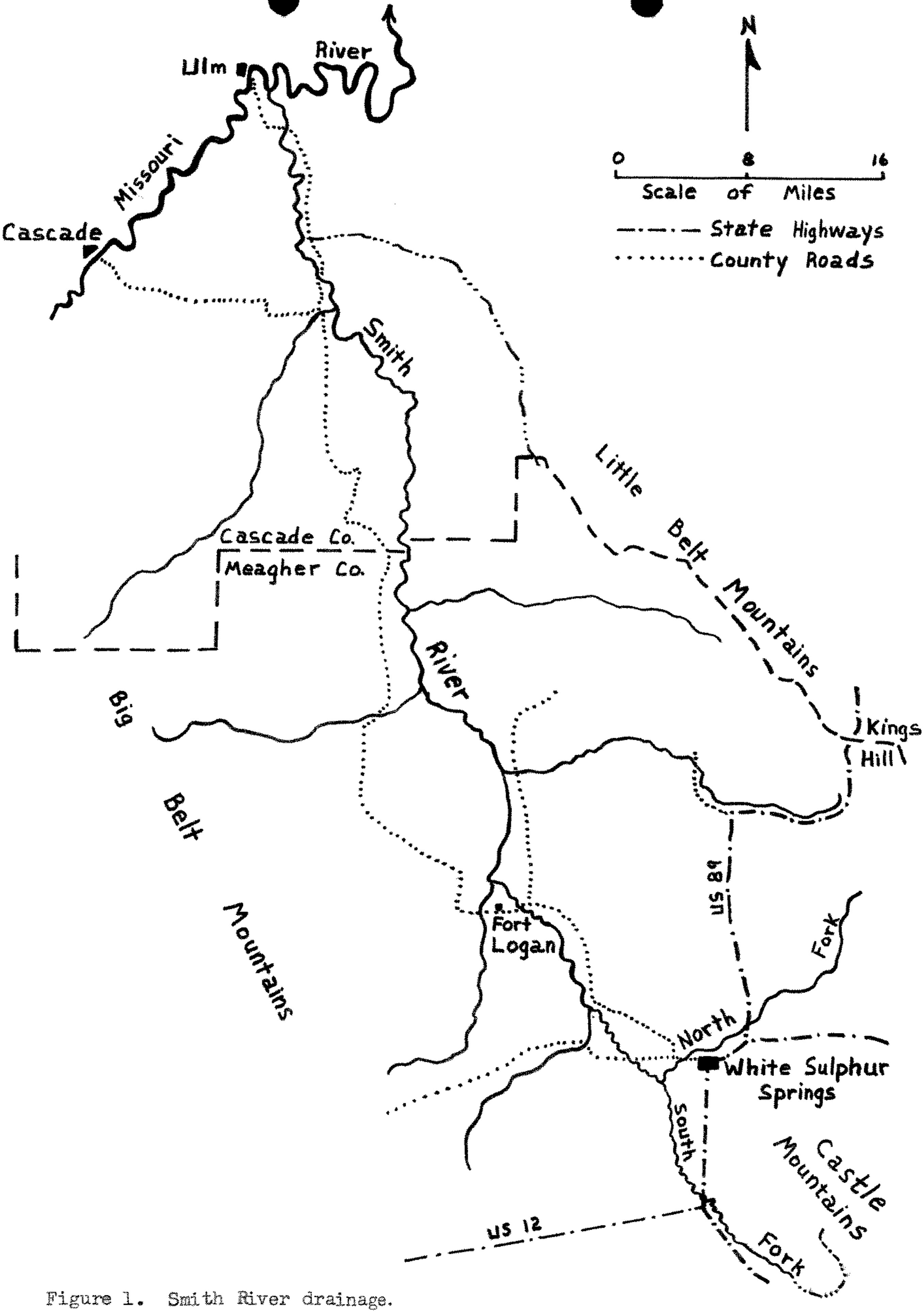

Figure 1. Smith River drainage.

and flowing generally northeasterly are Birch, Camas, Beaver, Rock, and Hound Creeks. Those from the Little Belt Mountains flowing generally westerly are Newlan, Sheep, Eagle, Tenderfoot, and Deep Creeks. A complete list of tributary streams within the drainage was compiled by Thoreson (1953); however, this list will not appear in this report.

The climate within the drainage is greatly influenced by the three mountain ranges previously mentioned. The extreme topographical conditions afforded by the mountain ranges and intermountain valleys cause the climate to be quite variable.

Winters in general are cold, with an occasional mild, open year. Prolonged cold spells may be abruptly terminated by the occurrence of a warm chinook and followed by mild weather. Snowfall has been recorded in every month of the year, and the average annual recorded snowfall is about 60 inches. Summers are characterized by wide diurnal temperature variations, low relative humidity and showers that are frequented by an occasional cloudburst.

Where climatic data has been officially recorded, mean annual temperatures vary from 34 degrees F at Kings Hill to about 45 degrees F at Ulm. Extreme recorded ranges between minimum winter and maximum summer temperatures are -61 degrees F at Fort Logan and 107 degrees F at Ulm. Average frost free periods are less than 30 days in many mountain valleys to about 130 days near the lower Smith River.

Average annual precipitation along the floor of the drainage varies from about 12 inches at Fort Logan to 16 inches near the mouth. Kings Hill records about 28 inches of precipitation annually. It is probable that some of the more favorable mountain areas receive 30 to 40 inches a year.

SMITH RIVER

Channel morphology and physical characteristics were measured in two sections of the Smith River in August, 1969. The Loney Ranch Section (T 10N, R 5E, S 26) is located about 10 miles northwest of White Sulphur Springs. This section of river flows through a meadow zone with a floodplain varying from 300 to 1,200 yards in width. The Zeig Ranch section (T 12 & 13N, R 4E, S 2 & 34) lies 25 miles northwest of White Sulphur Springs. This river section flows through a mountain zone where the floodplain width varies from 80 to 350 yards. The Zeig section lies at the entrance of the Smith River Canyon and contains the last vehicle access for about 20 river miles. The characteristics concerning the two river sections are presented in Table 1.

Trout populations were estimated from the two river sections on September 10 and 11, 1969. Population estimates in the Loney Ranch section reveal rainbow trout comprised about 53% of the number of yearling and older trout, brown trout 32% and brook trout 15%. Brown trout comprised about 58% of the standing crop (weight), rainbow trout 34% and brook trout 8% (Table 2). Hatchery rainbow trout are planted about one mile upstream from the section. They compr- ised less than two percent of the total standing crop by number and weight.

Table 1. Morphology and physical characteristics of two sections of the Smith River, August, 1969.

Channel Characteristic	Loney Section	Zeig Section
Length of channel measured (ft)	6,900	9,500
Average width (ft)	44.2	84.8
Average Depth (ft)	1.2	1.2
Average Thalweg Depth (ft)	1.9	1.8
Volume of flow, August 29 (cfs)	48	118
Sinuosity	1.6	1.2
Gradient (ft/mile)	23	27
Shoreline Characteristics		
Brush (%)	46.4	18.7
Grass (%)	33.3	60.4
Deposition Zone (%)	18.1	7.6
Cliff (%)	2.2	13.3
Supplemental Shoreline Characteristics		
Brush cover (ft^2/1,000 ft of channel)	1,877	210
Undercut (ft^2/1,000 ft of channel)	153	137
Eroding (%)	8.0	12.3

Table 2. Estimated trout populations from the Loney Ranch section of the Smith River, September, 1969. Section length - 8,435 ft. (95% confidence limits in parenthesis)

Age	Length Range	Number	Weight (lbs)
	Rainbow trout		
I	5.5 - 9.5	285	54.7
II	8.8 -12.8	67	33.3
III	10.1 -14.1	67	46.9
IV-V	13.6 -16.7	15	16.8
		434 (±111)	151.6
	Hatchery Rainbow trout		
-	8.4 -12.5	14 (± 10)	7.5
	Brown trout		
I	6.6 -10.4	134	33.0
II	11.2 -14.1	33	26.7
III	13.3 -17.8	48	75.2
IV	16.9 -19.1	41	91.1
V-VI	18.7 -22.0	17	43.0
		273 (± 50)	269.0
	Brook trout		
I	6.7 - 9.1	70	14.0
II	8.0 -11.9	50	21.5
III	11.0 -11.9	3	1.8
		123 (± 59)	37.3
Grand total		844	465.4
Standing crop per 1,000 ft		100	55.2
Standing crop per acre		99	54.4

Rainbow trout formed the bulk of the standing crop in the Zeig Ranch section (Table 3). They comprised about 92% by number and 78% by weight of the yearling and older trout. Brown trout comprised 8% by number and 22% of the total weight. Only 2 brook trout and 3 cutthroat trout were captured in the section. These five fish ranged from 8.8 to 10.6 inches in total length. Hatchery rainbow trout are planted near the head end of this section. The estimates revealed they comprised about 4% of the number and 7% of the weight of the total trout population.

Table 3. Estimated trout populations from the Zeig Ranch section of the Smith River, September, 1969. Section length - 10,750 feet. (95% confidence limits in parenthesis)

Age	Length Range		Number	Weight (lbs)
		Rainbow trout		
I	6.3 - 8.9		317	57.5
II	7.8 -11.0		302	90.0
III	9.7 -13.3		160	85.9
IV-V	11.5 -15.2		44	36.1
			823 (246)	269.5
		Hatchery Rainbow trout		
-	10.4 -13.5		38 (36)	24.5
		Brown Trout		
I	6.8 - 9.4		35	7.7
II	10.5 -14.2		7	7.2
III	14.8 -16.6		12	17.6
IV-V	16.8 -19.9		22	48.9
			76 (36)	81.4
Grand Total			937	375.4
Standing crop per 1,000 ft			87	34.9
Standing crop per acre			45	17.8

A total of 48 young-of-the-year rainbow trout were collected from both sections on September 3 and 4. The size range of these fish was 2.6-4.7 inches, with an average length of 3.6 inches. Young-of-the-year brown trout and brook trout were scarce. Mountain whitefish were abundant in both sections but were not collected.

The Loney Section supports about 58% greater biomass (weight) of trout per 1,000 feet of stream than the Zeig Section. The standing population of trout in any stream is controlled by the quantity and quality of available habitat.

The Loney Section has several pools associated with bank cover which offer desirable resting and hiding places for large trout. The Zeig Section contains little bank cover in relation to pools, and therefore the depth and bottom contours of these pools offer the only security for large trout. A note of conjecture is that most of the Smith River from the mouth of Sheep Creek to the mouth of Hound Creek physically resembles the Zeig Section.

The subsampling of the habitat in each section based upon the cross sectioning was not sufficient to accurately describe the quantity of pools and riffles. Cross section data was acquired every 100 feet in the Loney Section and every 200 feet in the Zeig Section. Ground observations on other streams reveal a cross section at intervals equivalent to the approximate average width of the channel would probably be sufficient to describe the pool-riffle complex. Following this rule, the Loney Section should have been cross sectioned about every 50 feet and the Zeig Section about every 100 feet.

SMITH RIVER TRIBUTARIES

Fish populations were sampled in 11 tributary streams during the fall of 1969. The data gathered from the inventory is presented in Table 4. Brook trout were found in 8 streams, cutthroat trout in 6 streams, and rainbow trout in 5 streams. Mottled sculpins were the only other fish species collected from the sections worked. Where some chemical work was done, conductivity ranged from 70 to 540 micromhos/cm and pH ranged from 6.3 to 8.5.

Detrimental practices to fish habitat were noted on several of these streams. The watersheds on Rock and Little Birch Creeks were noticeably overgrazed by livestock. Silt bars were common in these streams. The stream banks were badly trampled in several places and much of the streambank vegetation was in a deteriorated condition. Overgrazed stream banks were also evident on a considerable portion of the South Fork of Eight Mile Creek. Logging along a portion of the North Fork of the Smith River destroyed the natural channel of this stream. Trees had been clear cut along the stream; the unwanted debris and undesirable logs had been left where they fell with much of it in the stream channel. Considerable disturbance must have been dealt to the stream channel by men and machines during this logging operation.

Five maximum-minimum thermometers were placed in four Smith River tributary streams on August 6, 1969 and were read weekly until October 1, 1969. The weekly maximum-minimum water temperatures are presented in Table 5. The warmest readings were recorded on the South Fork of the Smith River. In late summer this stream flows less than 5 cfs and the water is heavily utilized for irrigation.

Water temperatures of 73 degrees F were recorded from the lower end of Sheep Creek, one of the largest tributaries of the Smith River. This stream flows through a narrow mountain canyon most of its length. Sheep Creek and its tributaries supply water for irrigation of about 1,900 acres within the drainage as well as supplemental water for about 1,200 acres in the Newlan Creek drainage.

Table 4. Inventory of some Smith River tributary streams.

Stream	Section Length (ft)	Location T. R. S.	Estimated flow(cfs)	Conductivity Micromhos/cm	pH	Fish Species	Number Caught	Length Range	Number over 6 inches T.L.
Benton Gulch	200	11N, 3E, 27	2	540	6.6	Eb[1]	30*	5.1 - 9.2	26
						Rb	21*	2.1 - 6.8	3
						RbXCt	5	5.0 - 6.5	3
Big Birch Creek	400	9N, 4E, 26	12	70	6.3	Eb	31	2.3 - 7.6	16
						Ct	4	5.3 - 8.0	3
	300	9N, 5E, 10	6	210	7.7	Eb	79*	3.3 -11.7	31
						Rb	24*	2.3 -11.9	8
Deep Creek	400	15N, 4E, 24	10	-	8.5	Ct	120*	3.4 -12.5	61
North Fork	125	15N, 5E, 20	6	-	8.5	Ct	54*	3.2 -10.0	25
North Fork 8 Mile Cr.	405	10N, 8E, 1	1	-	-	Eb	69	3.2 - 9.6	24
Camas Creek	250	10N, 4E, 34	8	170	8.2	Eb	55	2.6 -10.5	25
						Ct	2	7.2 -11.9	2
South Fork 8 Mile Cr.	300	10N, 8E, 24	3	-	-	Eb	33	3.3 - 7.5	6
						Rb	5	2.7 - 7.3	2
Four Mile Creek	300	9N, 8E, 17	6	100	7.5	Eb	60*	3.6 -10.7	28
						Ct	6	4.8 - 7.3	1
Little Birch Creek	300	9N, 5E, 31	3	-	-	Eb	10	2.8 - 8.5	8
						Ct	12	3.6 - 8.4	8
North Fork Smith River	320	11N, 8E, 25	10	-	-	Eb	100	2.6 -10.1	50
						Rb	7	3.6 -11.8	3
Rock Creek	310	13N, 2E, 30	8	225	-	Rb	31*	2.2- 10.1	9
						RbXCt	4*	4.3 - 9.0	1

*Many of the young-of-the-year fish not captured.
1/ Abbreviations: Eb, brook trout; Rb, rainbow trout; Ct, cutthroat trout; RbXCt, rainbow trout-cutthroat trout hybrid.

Table 5. Maximum-minimum water temperatures from tributaries in the Smith River drainage, 1969. (Expressed in Fahrenheit degrees).

Period Covered	Sheep Creek (Upper) T12N,R7E,S26	Sheep Creek (lower) T12N,R5E,S18	North Fork Smith River T9N,R6E,S13	South Fork Smith River T9N,R6E,S21	Rock Creek T13N,R3E,S31
8/6 to 8/13	62 - 42	70 - 50	68 - 45	71 - 48	65 - 48
8/13 to 8/20	62 - 54	71 - 51	70 - 52	71 - 52	66 - 48
8/20 to 8/28	64 - 46	73 - 53	70 - 55	74 - 62	66 - 48
8/28 to 9/4	-	68 - 46	66 - 47	69 - 43	63 - 43
9/4 to 9/11	60 - 39	64 - 43	63 - 46	66 - 42	-
9/11 to 9/17	59 - 38	67 - 42	65 - 45	67 - 41	63 - 42
9/17 to 9/24	54 - 40	59 - 46	61 - 44	64 - 40	57 - 44
9/24 to 10/1	52 - 38	-	58 - 44	60 - 41	54 - 45

Although Sheep Creek is fairly well shaded within the narrow canyon it traverses, the wide, shallow stream channel characteristic of the stream contributes to warm summer water temperatures. Increased diversion of flow into the Newlan Creek drainage and increased development of irrigable lands within Sheep Creek drainage could cause higher maxima and diurnal variations in water temperatures in Sheep Creek. These changes in the water temperatures could possibly have a detrimental impact on the existing fish and aquatic insect populations.

Water temperatures were also secured from the Smith River near the mouth of Hound Creek with the aid of a thermograph. Up to June 30, 1970, the maximum water temperature recorded was 68 degrees in late June. Review of water temperature records secured from the same location reveal a history of high temperatures. Thermograph records covering the summers of 1962 through 1964 revealed water temperatures over 70 degrees each year. During July and August 1963, daily maximum water temperatures varied from 70 to 79 degrees every day over a 31 day period. Spot observations by USGS personnel from 1951-65 also reveal water temperatures over 70 degrees.

Discharge monitoring stations were set up on 10 streams within the drainage. The locations of these stations are presented in Figure 2. The staff gages installed at each location were read about twice a week during spring runoff and about weekly after flows had stabilized later in the summer. Since these stations were set up in the spring of 1970, the data will not appear in this report in order that the information may be reported on over a complete field season. An example of a discharge curve and monitored flow is presented in Figure 3.

Recommendations:

The field inventory of the aquatic resources and factors influencing these resources will be the basis for development of a fishery management plan for the Smith River drainage. The collection of field data should continue to complete the inventory. Emphasis for the next field season will be placed on the association of fish populations and habitat, water quality, angler use, availability of waters, and landowner-recreationist relationships.

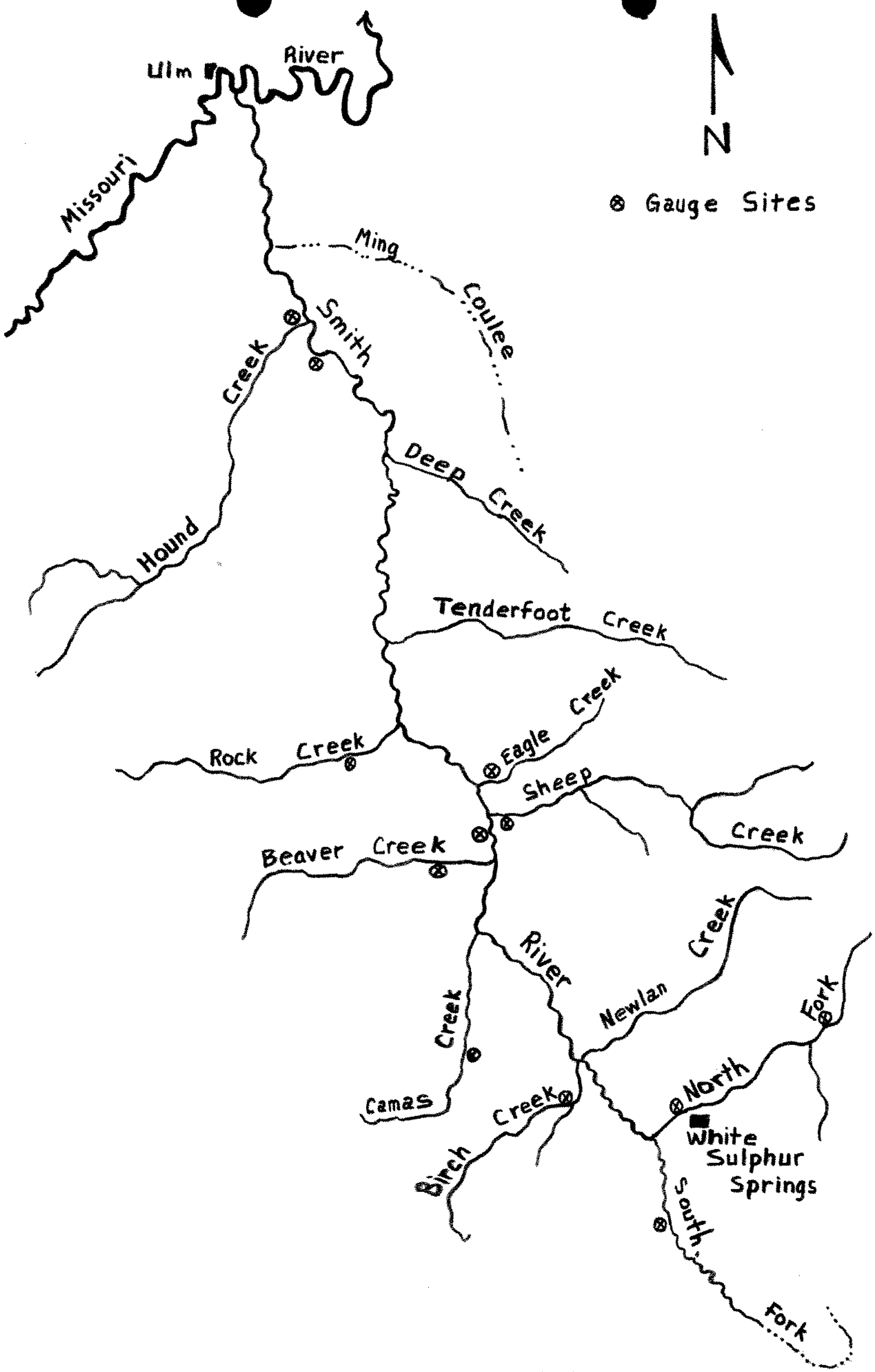

Figure 2. Smith River drainage and major subdrainages.

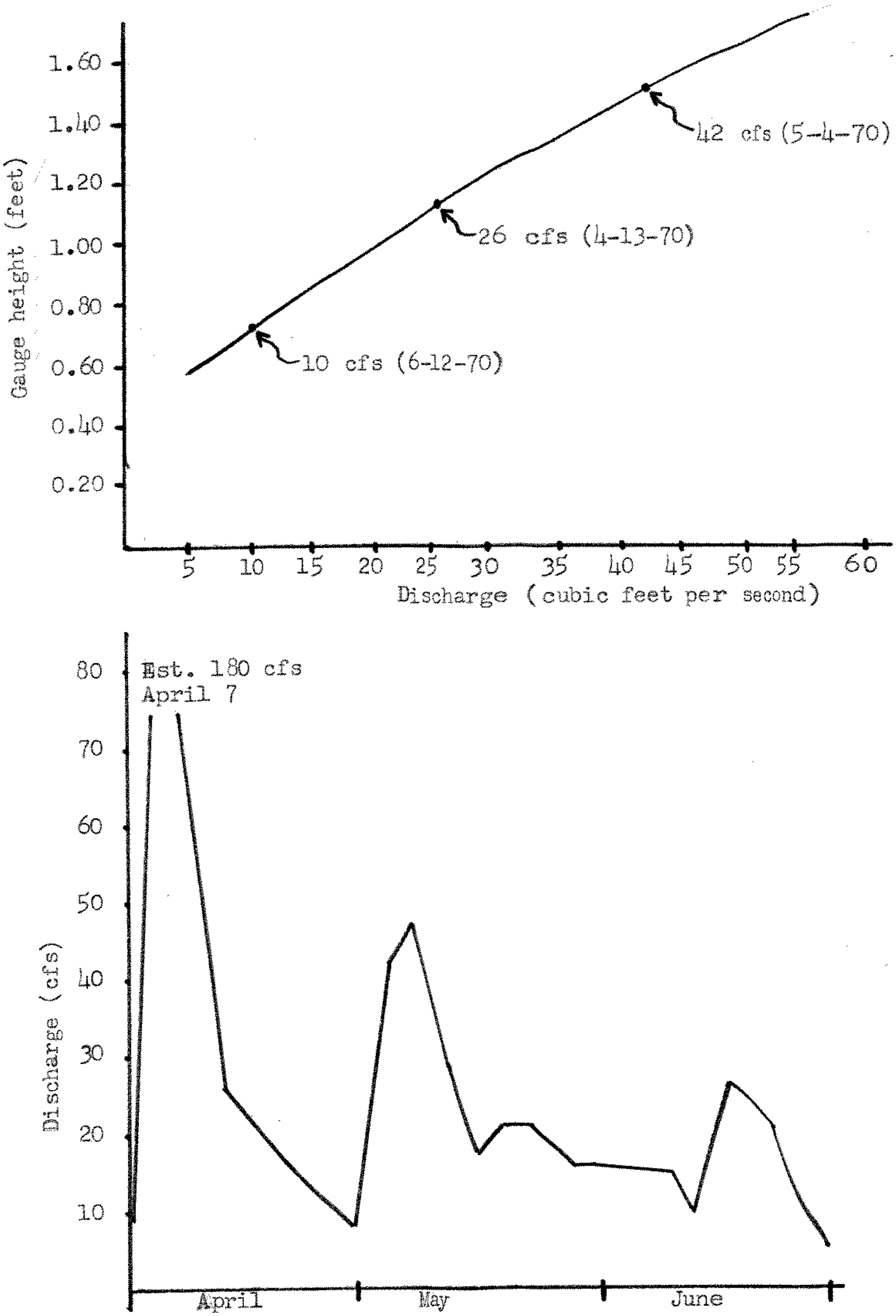

Figure 3. Top: Discharge curve constructed from flow measurements. Bottom: Flow regime of South Fork of Smith River interpolated from staff gauge readings and discharge curve.

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Prepared by A. H. Wipperman

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17-1184	17-3600	17-5280	17-6544	17-7056
17-1980	17-4112	17-5328	17-6816	17-7536