ENVIRONMENTAL
PROTECTION
AGENCY — REGION IX

MIDDLE FORK
of the
FEATHER RIVER

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San Francisco, California

WATER QUALITY SURVEY
Biology - Microbiology

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ABSTRACT

An aquatic biological and microbiological survey was conducted during September 1970 on Middle Fork Feather River, California at the request of the California State Water Quality Control Board. The baseline information gained will enable the Board to establish water quality standards for Middle Fork Feather River which has been designated by the U. S. Congress as a National Wild and Scenic River. The study includes a biological assessment of the plankton, aquatic plants, attached algae, benthic invertebrates, *in situ* chlorophyll and algal growth potential, and an assay of selected bacterial pollution-indicators within the area. Information on chemical and physical parameters is being collected by the U. S. Geological Survey and the California Department of Water Resources. The condition of the biota and the areas of suspected bacterial contamination are documented. A follow-up monitoring program is recommended if increased development of Sierra Valley or that area upstream of the valley endangers planned recreational uses.

I. INTRODUCTION

GENERAL

In 1968, under provisions of P. L. 90-542, Congress designated the Middle Fork Feather River as part of the National Wild and Scenic Rivers System and assigned the U. S. Forest Service, Department of Agriculture, responsibility for administering management of the River. The Plumas National Forest and the California State Water Quality Control Board requested technical assistance from the Environmental Protection Agency (EPA), formerly Federal Water Quality Administration (FWQA), to conduct a baseline study of biological and microbiological parameters of the River. Data developed by this survey will assist the Board in setting water quality standards.

An Interagency Cooperative Study Committee was formed representing the Forest Service, Geological Survey, EPA, California Central Valley Regional Water Quality Control Board, California Department of Water Resources, and Plumas County to coordinate a joint study of the Middle Fork Feather River system. The Forest Service coordinated the study; Geological Survey and California Department of Water Resources were responsible for collecting water samples and making physical measurements on the River, and Plumas County was responsible for public health.

As a part of its assigned responsibility the EPA conducted a biological and microbiological field study on the Middle Fork Feather River system on September 14-16, 1970, to obtain water quality evaluation and background data for water quality management. A description of the study and results obtained are presented in this report.

ACKNOWLEDGEMENTS

Field sampling and laboratory analyses were conducted by: Helen M. Johnson, Biological Aide (coliform assays); Albert Katko, Aquatic Biologist (algae); W. Arthur Noble, Biological Technician (invertebrates); Robert E. Peterson, Physical Science Technician (sample collection); Kathleen G. Shimmin, Supervisory Microbiologist (coliform assays). This report was prepared under the direction of William C. Johnson, Supervisory Aquatic Biologist.

II. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

1. As reflected by the biota, water quality of Middle Fork Feather River and sampled tributaries appears to be best at Milsap Bar, the sampling station furthest downstream.

2. Advanced eutrophication in Sierra Valley is indicated by various biological parameters: planktonic cell counts, submerged dense aquatic weed beds, and the kinds and number of benthic invertebrates.

3. The Recreation Zone (Sierra Valley) is characterized by large total populations of organisms and by particular organisms common to slow-flowing streams containing organic materials. Conversely, the River downstream of Sierra Valley contains fewer total organisms and a greater variety of those species indicating a cclean water environment.

4. Total and fecal coliform bacteria were measured at all stations sampled. Total coliform levels ranged from 350- 2700/100 ml; fecal coliforms ranged from 20-380/100 ml. Although some fecal-coliform levels were indicative of possible contamination, the high total coliform counts seem due to soil organisms of nonfecal origin.

RECOMMENDATIONS

Biological studies should be repeated every two years to record any changes in the aquatic environment that could be related to violations of water quality standards. Microbiological surveys should be made annually during periods of low streamflow to pin-point sources of contamination. Since there are plans to develop large recreation tracts in and above Sierra Valley, these activities should be monitored and follow-up surveys made to determine whether or not water quality has deteriorated and violations of water quality standards have occurred.

III. STUDY DESCRIPTION

DESCRIPTION OF STUDY AREA

The Middle Fork Feather River is located on the western slope of the Sierra Nevada Mountains and flows west

from Sierra Valley 108 miles to Oroville Reservoir. As depicted in Figure 1, the River can be divided into five portions: a Recreation Zone, two Scenic Zones, and two Wild River Zones.

Sierra Valley, in the heart of the Recreation Zone, is a sparsely populated area containing farms and cattle ranches. It is approximately 18 miles long and 12 miles wide with an elevation of about 5000 feet. Numerous creeks meander throughout the valley in a profusion of small, interconnected waterways which are part of a developed irrigation system. These waterways join to make a river near the town of Beckwourth. The Davis and Frenchman Reservoirs, just upstream of Sierra Valley, discharge controlled releases into the river system. Portola, (population 1820) in Sierra Valley, is the largest community in the drainage. Collected sewage from the town is treated in lagoons located just upstream of Delleker, a sampling station, and the treated effluent slowly returns to the river via seepage.

The River flows from Sierra Valley to Clio, turns northwest, passes through Mohawk Valley, then bends southwest and flows into the Middle Fork Feather River Canyon near Sloat. Downstream from Sloat the Spring Garden Railroad Tunnel marks the beginning of the English Bar Scenic River Zone, an area which extends about six miles to Nelson Creek.

The Upper Canyon Wild River Zone, starting at Nelson Creek, extends about 28 miles, passing through Devil and Franklin Canyons to an area upstream of Devil's Gulch. The next section, Milsap Bar Scenic River Zone, stretches about four miles to a point below Milsap Bar Campground. The second Wild River Zone, Bald Rock Canyon, includes the remaining downstream portion of the River to its entry into Lake Oroville at a 900 foot elevation. Over 90 permanent and temporary tributary streams drain into the Middle Fork Feather from its headwaters, and these additional waters increase the flow of the River from 4 cfs at Beckwourth to 159 cfs at Milsap Bar during the study.

The Interagency Cooperative Study Committee selected 38 sampling stations (Table I). Biological sampling was performed at 10 stations and microbiology at 18 of the selected stations. This limitation was determined by the Committee on the basis of the need for biological and microbiological information..

METHODS

Bacterial samples assayed for total- and fecal-coliform

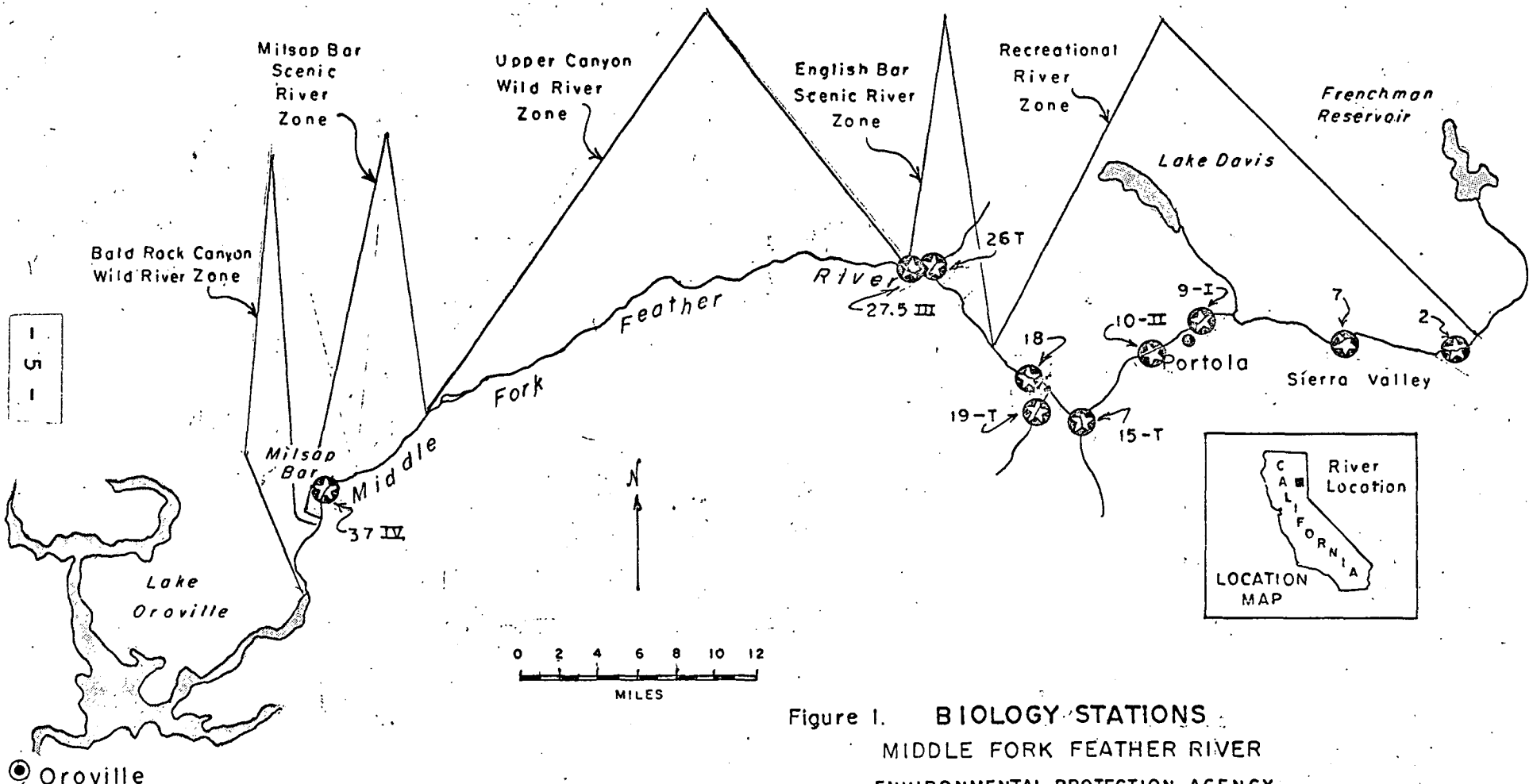

Figure 1. BIOLOGY STATIONS
MIDDLE FORK FEATHER RIVER
ENVIRONMENTAL PROTECTION AGENCY
REGION IX

TABLE I

Interagency Cooperative Study

Middle Fork Feather River Basin - Stations

Station Number	Name	Location
1-T	Little Last Chance Creek north of Chilcoot	23N/16E-10NE1/4
2	Middle Fork Feather River at Summit School	23N/16E-33NE1/4
5-T	Tributary to Middle Fork Feather River off Marble Lane	22N/15E-18NE1/4
7	Middle Fork Feather River at Beckwourth	23N/14E-27NE1/4
9-I	11-3921, Middle Fork Feather River near Portola	23N/14E-29NW1/4
10-II	11-3922, Middle Fork Feather River at Delleker	22N/13E-3NE1/4
13	Middle Fork Feather River above Willow Creek	22N/13E-30NW1/4
15-T	Sulfur Creek near mouth	22N/12E-25SE1/4
18	Middle Fork Feather River below Graeagle Creek	22N/12E-15SE1/4
19-T	Graeagle Creek near mouth	22N/12E-15SE1/4
20	Middle Fork Feather River above Smith Creek	22N/12E-9SE1/4
21	Smith Creek near mouth	22N/12E-9SE1/4
22	Middle Fork Feather River above Jamison Creek	23N/12E-31NE1/4
23-T	Jamison Creek near mouth	23N/12E-30SE1/4

TABLE I. (Continued)

Station Number	Name	Location
26-T	Long Valley Creek near mouth at railroad bridge	23N/11E-15NE1/4
27.5-III	11-3933, Middle Fork Feather River below Long Valley Creek at Sloat	23N/11E-10SW1/4
28	Middle Fork Feather River at Nelson Point Bridge	23N/10E-15NW1/4
32	Middle Fork Feather River below Cleghorn Bar (3/4 mile)	23N/9E-30SW1/4
37-IV	11-3945, Middle Fork Feather River near Merrimac (Milsap Bar)	21N/6E-2NE1/4

counts were collected by four teams. One of these teams used a helicopter to gather samples in otherwise inaccessible areas and also to reduce travel time. A mobile laboratory used for performing bacteriological tests was based at the Forest Service's Mohawk Ranger Station near the midsection of the River. Methods used were in accordance with those described in the 12th Edition of STANDARD METHODS with the following modifications: samples were iced in transit; membrane filter method was employed using mEndo and mFC agars; samples were replicated in triplicate; all samples were processed within five hours after collection.

Biological samples were collected to determine the phytoplankton, periphyton, chlorophyll, algal growth potential (AGP) levels as well as the number of benthic invertebrates in the River. Phytoplankton samples were collected in 1-liter plastic bottles filled in midstream just below the surface of the water and preserved in 4% formalin. Periphyton samples were collected by scraping rocks, twigs, and other fixed objects and then preserved in 4% formalin. Chlorophyll samples were obtained by filtering 500 ml of water, collected just below the surface, through a Watman GF/C filter, which then was placed in a desiccator jar and frozen with dry ice. AGP samples were collected in 1-gallon glass bottles filled in midstream just below the surface of the water. The samples were then stored in cool, dark containers. Benthic invertebrate samples were collected on a 1-1/2 ft. x 3 ft. hand screen with 0.5 mm openings (Figure 2). Rocks and gravel in a 4 square foot area were brushed and roiled causing organisms present to break loose and become trapped on the screen. The trapped material was washed into a large bucket and the screen process repeated several times at different depths, flows, and substrates, so that all habitats at each station were sampled. The bucket's contents were then poured through a US-35 sieve (0.495 mm openings); residue was placed into wide-mouth quart jars and preserved in 10% formalin.

In the laboratory, biological samples were processed in accordance with previous procedures in Water Quality and Aquatic Biology East Fork Kaweah River, FWQA, Pacific Southwest Region, August 1969. There were exceptions to the previous work: some invertebrate samples were fractioned and a subsample removed; all organisms were picked from the aliquot and sorted as to kind. In some cases, because of high numbers certain organisms required further subsampling. Stirring was used to insure uniformity in subsamples.

Figure 2. Benthic Invertebrate sampling technique.

IV. RESULTS AND DISCUSSION

In a water quality survey the nature of the stream biota is catalogued, since it reflects any change in the environment. The Middle Fork Feather River is similar to the Pit and Klamath Rivers. All three originate in the high desert regions containing volcanic soil, sage brush and Ponderosa Pine, they then meander slowly through valleys 4000 to 5000 feet high used for cattle-grazing and hay production. The rivers then plunge through steep canyons. Here the flows are enlarged by springs and tributary streams containing water low in dissolved solids and nutrients. The biota which was collected and examined during this study reflects these conditions in the Middle Fork Feather River.

PLANKTON

In general, swift-flowing mountain rivers such as the Middle Fork Feather River do not support a significant plankton population. It was found, however, that in the areas of the Recreation Zones where the River was slow-flowing or downstream of a slowly-flowing reach, large numbers of planktonic algae were found (Table II).

Algal counts were highest at Beckwourth, Delleker, and Sloat (Stations 7, 10-II, and 27.5-III). Beckwourth and Delleker are below pooled areas which can develop individualistic blooms; this fact was reflected by the abundance of green algae and flagellates found. The predominant planktonic alga at Sloat was a diatom, Epithemia. This organism was also dominant among the benthic algae. On the tributary streams the algal counts were highest at Sulfur Creek, which also had a high proportion of green flagellates.

CHLOROPHYLL

Chlorophyll samples were used to quantify the planktonic algae. Since the amount of chlorophyll varies with the kind of algae and its physiological state, a close correlation between chlorophyll and the cell count does not exist. If only chlorophyll data are examined, there appears to be little significant difference between the stations above the confluence of Graeagle Creek and those located downstream, even though there is a trend toward decreasing chlorophyll concentration (Table III, Figure 3). Sulfur Creek, a tributary, had the highest observed level of chlorophyll. This was possibly due to the large concentration of green flagellates.

TABLE II. PLANKTONIC ALGAE MIDDLE FORK-FEATHER RIVER AND TRIBUTARIES
September 15, 1970

Stations	2	7	9-I	10-II	18	27.5-III	37-IV	15-T	19-T	26-T
Green										
Ankistrodesmus	-	132	-	16	-	-	-	-	-	-
Closteriopsis	-	32	-	-	-	-	-	-	-	-
Kirchneriella	-	64	-	32	-	16	-	-	-	-
Scenedesmus	-	160	-	48	-	-	32	16	-	-
Staurastrum	-	32	-	-	-	-	-	-	-	-
Tetraedron	-	32	-	-	-	-	-	-	-	-
Tetrastrum	-	64	-	16	-	-	-	-	-	-
Blue-Green										
Anabaena	32	-	-	-	-	-	-	-	-	-
Oscillatoria	-	-	-	-	-	-	-	-	16	-
Green Flagellates										
Carteria	-	-	-	-	-	-	-	32	-	-
Chlamydomonas	-	-	-	16	-	-	16	48	-	-
Euglena	-	-	-	16	-	-	-	16	-	-
Other Pigmented Flagellates										
Cryptomonas	-	320	48	16	-	-	-	-	-	-
Gymnodinium	-	-	-	16	-	-	-	-	-	-
Diatoms										
Achnanthes	-	-	16	-	-	-	-	48	-	-
Cocconeis	-	-	-	-	-	-	-	-	16	-
Cyclotella	-	160	-	16	79	32	-	32	-	-
Cymbella	16	-	-	-	-	-	-	-	63	-
Epithemia	-	-	-	-	-	127	-	-	-	-
Fragilaria	16	-	-	-	-	-	-	16	32	-
Melosira	-	192	16	-	-	-	-	16	-	-
Navicula	32	-	-	-	16	32	-	48	-	-
Nitzschia	48	288	63	32	48	-	-	143	32	-
Rhopalodia	-	-	-	-	-	16	-	-	-	-
Stephanodiscus	-	960	-	111	-	-	-	-	-	-
Synedra	-	-	-	-	16	32	-	-	-	16
TOTAL per ml.	144	2436	143	334	159	255	48	415	159	16

TABLE III

IN SITU CHLOROPHYLL A

MIDDLE FORK FEATHER RIVER

September 17, 1970

Stations	ug a/l
Summit School	1.26
Beckwourth	1.86
Near Portola	2.16
Delleker	1.80
Sulfur Creek	3.18
Graeagle Creek	0.42
Below Graeagle Creek	0.90
Long Valley Creek	0.30
Sloat	0.39
Milsap Bar	0.27

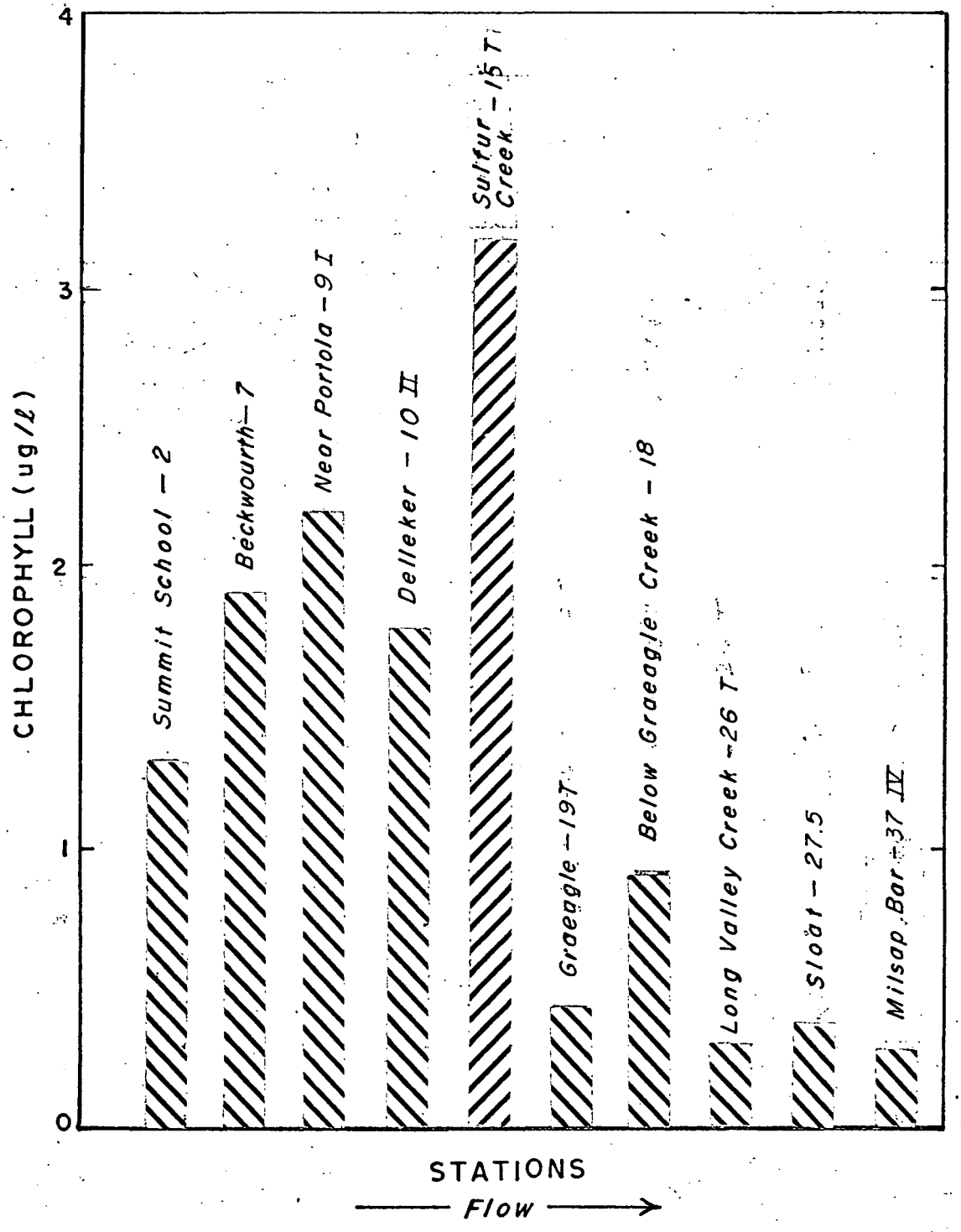

Figure 3. IN SITU CHLOROPHYLL A
SEPT., 1970
MIDDLE FORK FEATHER RIVER
ENVIRONMENTAL PROTECTION AGENCY
REGION IX

ALGAL GROWTH POTENTIAL (AGP)

The algal growth assays indicate high growth potentials at Beckwourth and Sloat (Stations 7 and 27.5-III). The maximum AGP occurred at Sloat and the minimum occurred at Milsap Bar (Station 37-IV, Table IV). The Beckwourth sample reached its highest growth far in advance of the other samples. This might be due to a higher initial quantity of indigenous algae. Figure 4 illustrates a chlorophyll response from the Sloat assay which is almost 10 times that of other samples. To place this data in perspective, Figure 5 shows the algal-growth-assay studies from three San Joaquin Valley rivers with different degrees of eutrophy. The AGP method of evaluation of water quality assesses the impact of nutrients on a water supply, and has been employed previously as a parameter in the interstate water quality standards for Lake Tahoe (Bain, 1969).

AQUATIC VEGETATION

Aquatic vegetation other than planktonic algae and periphyton flora included the visible algal growths and aquatic plants. Identifications by station are shown in Table V. The only plants collected were those either completely or partially submerged in the water, i.e., with either their stems, leaves, or flowers above the water or floating on the surface. Plants such as willows, sedges, and alders growing along the River's edge were not collected.

Visible growths of filamentous algae and aquatic plants in a riverbed indicate nutrient enrichment. Near Portola and below Graeagle Creek (Stations 9-I and 18), submerged beds of buttercups, Ranunculas cincinatus, were found. The beds ranged in size from 50 to 100 feet long and 10 to 50 feet wide and covered almost half of the river surface at the riffles sampled. A moss, Fissidens, was found clinging to the rocks near Portola (Station 9-I) and covered more than 80 percent of all cobble-size rocks in the riffle. At Beckwourth (Station 7), the pond lily, Nuphar polysepalum, and narrow-leaved cattail, Typha, were collected. These plants are indicative of nutrient-rich, slow-flowing water or ponds, and their occurrence suggests the river level has a small annual fluctuation and could receive nutrients from irrigation runoff. There was little visible aquatic vegetation at Sloat and Milsap Bar (Stations 27.5-III and 37-IV). The geomorphology suggests that the River's velocity and annual fluctuation here is too large to provide a suitable habitat for these plants.

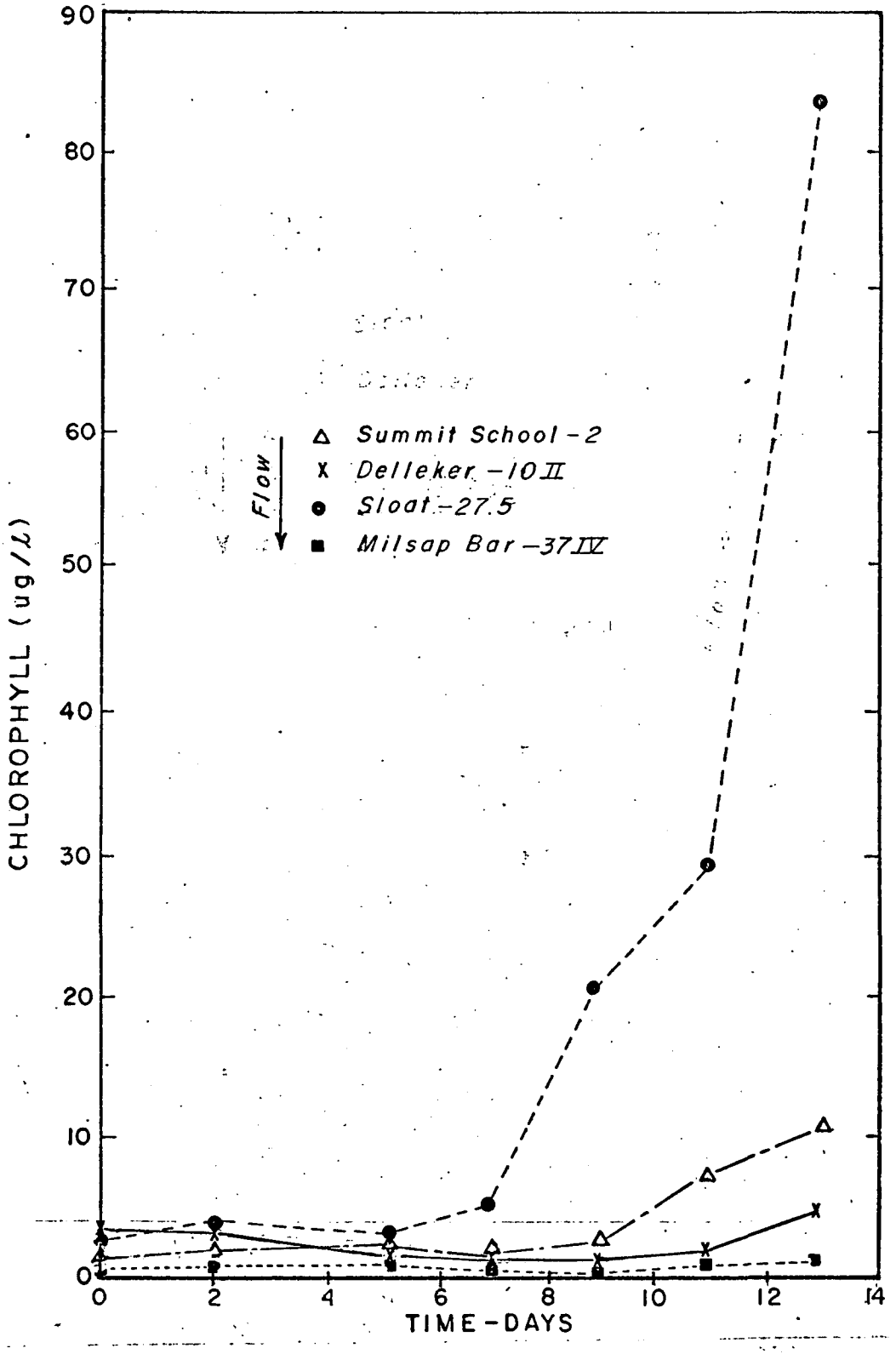

Figure 4. ALGAL GROWTH POTENTIAL
SEPT. 1970
MIDDLE FORK FEATHER RIVER
ENVIRONMENTAL PROTECTION AGENCY
REGION IX

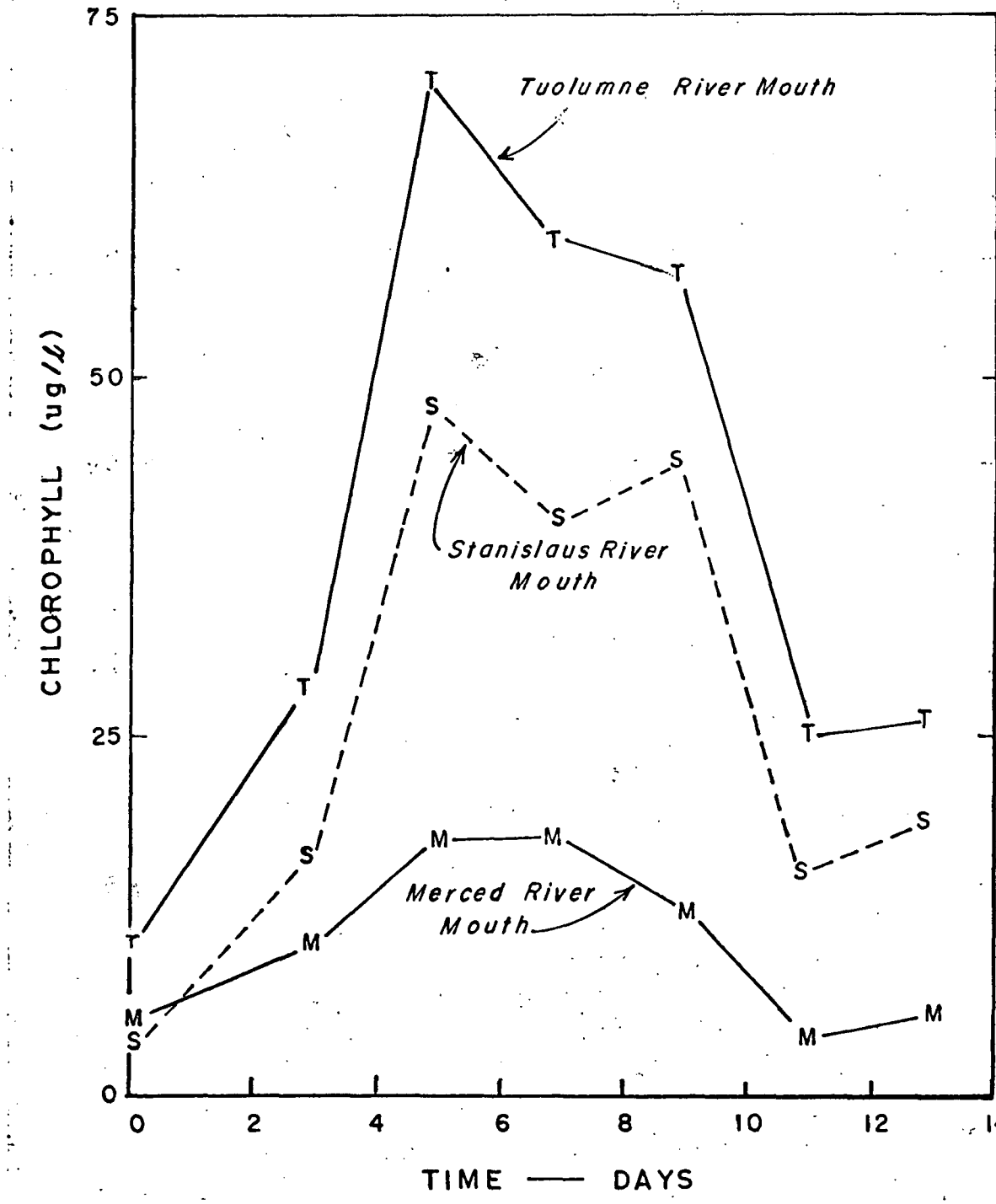

Figure 5.

ALGAL GROWTH POTENTIAL
SAN JOAQUIN RIVER TRIBUTARIES

MIDDLE FORK FEATHER RIVER

ENVIRONMENTAL PROTECTION AGENCY
REGION IX

TABLE IV
ALGAL GROWTH POTENTIAL
CHLOROPHYLL A ug/l
MIDDLE FORK FEATHER RIVER

Station Name	Days Incubated 0	2	5	7	9	11	13
Summit School	1.20	1.50	2.16	1.77	2.82	7.5	11.55
Beckwourth	14.16	31.80	25.89	10.89	6.75	11.85	14.10
Near Portola	2.55	5.25	3.57	2.52	2.52	2.37	2.64
Delleker	4.08	3.90	1.71	1.47	1.29	1.68	4.44
Sulfur Creek	2.76	6.30	4.68	2.79	3.06	15.00	28.20
Graeagle Creek	0.33	0.51	1.50	1.06	1.17	1.44	2.31
Below Graeagle Creek	1.77	4.20	1.59	2.40	6.00	2.40	2.04
Long Valley Creek	0.45	0.36	0.45	0.45	0.72	2.46	1.17
Sloat	2.82	4.05	3.36	5.67	21.75	36.60	84.00
Milsap Bar	0.60	0.84	1.35	0.84	0.69	0.96	2.13

The visible algae, shown in Table V, grew in beds or various sized patches which generally occupied the entire stream bed. Vivid green beds of Cladophora were present in the shallow, swift flowing waters at Beckwourth and Delleker, and also below the confluence of Graeagle Creek (Stations 9-I, 10-II, and 26-T). Spirogyra was more common in the still waters or pooled areas. Visible beds of filamentous blue-greens were not common, and were primarily confined to a few rocks coated with organic sediment. Only at Graeagle Creek were slime growths formed by diatoms, and these were in a nearly stagnant pooled area containing recently decomposed organic sediment. Stations within and downstream of the Scenic River Zone were devoid of any macro-growths of algae.

Table VI lists, by percent abundance, the microscopic forms of benthic algae (periphyton flora) that were common to each station. The benthic algae were primarily diatoms and filamentous blue-greens. The percentages listed indicate relative abundance only, since quantitativeness based on population density is not practical or representative of single samples of this type. Benthic algae were found at all stations, but the percentage composition indicates that coccoid greens, filamentous greens, coccoid blue-greens, and filamentous blue-greens were only found at stations in Sierra Valley and at the sampled tributaries. Diatoms were found at all localities sampled. Some of the diatoms identified in this study, such as Gomphoneis and Gomphonema, have also been found at Lake Tahoe where they are considered a nuisance due to their massive slime growths on piers and rocks. Other diatoms collected, i.e., Navicula, Nitzschia, and Synedra, are associated with slime growths and are generally common to the Tahoe Basin.

BENTHIC INVERTEBRATES

Over 109,000 benthic invertebrate ogranisms were collected during the study and 110 different kinds were identified. Table VIII, percent occurrence by major taxonomic groups, indicates that the mayfly, caddisfly, and stonefly groups which are highly sensitive to the quality of water, constitute over 60 percent of the invertebrate populations at all stations except Summit School and Beckwourth (Stations 2 and 7). Segmented roundworms, pollution tolerant invertebrates, constituted over 96 percent of the invertebrate populations at Summit School, and 37 percent at Beckwourth. Only low proportions were found at all other stations.

Since roundworms, as organic-detritus feeders (Pennak, 1953), are strongly influenced by the amount of organic

TABLE V
VISIBLE ALGAL GROWTHS AND AQUATIC PLANTS COLLECTED
MIDDLE FORK FEATHER RIVER
September 1970

Station Number	Algae	Aquatic Plants
2	Oedogonium (filamentous green)	Potamegeton sp. (pond weed) Anacharis canadensis (Elodea)
7	Cladophora (filamentous green) Spirogyra (filamentous green)	Glyceria leptostachya (grass) Typha angustifolia (cattail) Nuphar polysepalum (waterlily)
9-I	Spirogyra (filamentous green)	Anacharis canadensis (Elodea) Fissidens sp. (moss) Ranunculus circinatus (buttercup)
10-II	Cladophora (filamentous green) Oedogonium (filamentous green)	Anacharis canadensis (Elodea)
15-T	Oscillatoria (filamentous blue-green)	Ranunculus circinatus (buttercup) Nasturtium officinale (cress) Lemna trisulca (duckweed) Lemna minor (duckweed) Veronica beccabunga (speedwell) Glyceria sp. (grass)
18	Cladophora (filamentous green) Nostoc (filamentous blue-green)	Ranunculus circinatus (buttercup) Epilobium californicum (willow herb)
19-T	Tribonema (filamentous green) Cymbella (diatom) Spirogyra (filamentous green) Oscillatoria (filamentous blue-green)	--
26-T	--	--
27.5-III	--	--
37-IV	--	--

TABLE VI. PERCENT ABUNDANCE OF BENTHIC ALGAE - MIDDLE FORK FEATHER RIVER
September 15, 1970

Stations:	2	7	9-I	10-II	15-T	18	19-T	26-T	27.5-III	37-IV
Coccoid Green										
Ankistrodesmus	-	-	5	-	*	*	-	-	-	-
Closterium	-	-	-	-	-	-	-	1	-	-
Cosmarium	-	-	-	-	-	2	-	-	-	-
Pediastrum	-	-	-	-	*	-	-	-	-	-
Scenedesmus	-	-	-	*	4	*	*	-	*	-
Filamentous Green										
Basicladia	-	-	*	*	-	-	-	-	-	-
Spirogyra	-	-	-	*	-	-	*	-	-	-
Tribonema	-	-	-	-	-	1	2	-	-	-
Coccoid Blue-Green										
Aggmenellum	1	-	-	-	-	-	-	-	-	-
Filamentous Blue-Green										
Calothrix	-	-	5	12	-	-	-	-	-	-
Nostoc	-	-	-	-	-	16	-	8	-	-
Oscillatoria	*	-	2	-	47	-	65	-	-	*
Typothrix	-	-	-	-	-	*	-	-	-	-
Diatoms										
Achnanthes lanceolata	-	-	-	-	-	-	-	*	-	1
minutissima	-	-	-	-	-	-	4	-	-	3
Amphipleura pellucida	3	-	-	-	-	2	-	-	-	*
Amphora ovalis	-	-	-	-	-	*	-	-	-	1
Cocconeis placentula	*	-	5	-	3	13	2	8	1	27
Cyclotella bodanica	*	-	-	-	-	-	-	-	-	-
meneghiniana	-	*	-	-	-	*	-	-	-	1
Cymbella affinis	*	-	5	-	-	*	13	*	-	1
sinnuata	*	-	5	-	*	*	7	4	-	3
tumida	-	71	-	-	3	-	-	-	-	-
ventricosa	2	-	*	-	-	*	2	-	-	-
sps.	*	-	-	-	-	-	-	-	-	-

TABLE VI. PERCENT ABUNDANCE OF BENTHIC ALGAE (Continued)

Stations:	2	7	9-I	10-II	15-T	18	19-T	26-T	27.5-III	37-IV
Diatoms (continued)										
Diatoma vulgare	6	-	2	-	-	2	-	-	-	3
Diplioneis smithii	1	-	-	-	-	-	-	-	-	-
Epithemia sorex	-	-	-	75	-	16	-	2	83	22
turgida	-	-	-	-	-	-	-	-	4	*
Fragilaria construens	*	-	-	-	-	1	-	-	-	*
Gomphoneis herculeana	*	-	-	-	-	*	-	*	*	*
Gomphonema intricatum	-	-	-	*	-	-	-	*	-	*
lanceolatum	-	-	-	-	-	-	-	61	-	5
longiceps	-	*	-	-	-	-	-	-	-	-
parv lum	-	-	-	*	*	-	-	-	-	-
Gyrosigma acuminatum	-	-	-	-	-	*	-	-	-	-
Navicula bacillum	-	-	-	-	-	-	-	-	-	*
cryptocephala	5	-	7	3	9	4	2	6	-	5
decussis	-	-	*	-	-	*	-	-	-	1
gracilis	-	-	20	2	5	3	-	-	-	2
pupula	-	-	2	*	*	*	-	-	-	-
radiosa	-	-	-	-	-	-	-	1	-	1
salinarium	36	*	5	2	12	10	2	*	7	3
sps.	*	-	*	-	*	*	-	-	-	*
Nitzschia amphibia	*	-	2	-	*	2	-	-	-	-
dissipata	27	-	5	*	*	7	-	*	*	3
filiformis	-	7	11	2	3	5	-	*	-	4
fonticola	-	-	2	*	*	-	-	*	-	*
holsatica	-	4	*	-	-	-	-	-	-	-
kutzingiana	-	-	-	*	-	-	-	1	-	1
pelea	7	8	7	2	6	5	-	*	-	*
sps.	-	-	-	-	*	-	-	*	-	*
Rhicosephenia curvata	-	-	2	-	-	*	-	1	-	1
Rhopalodia gibba	-	-	-	*	-	2	-	1	1	-
Surirella elegans	-	-	-	-	-	*	-	-	-	-
Synedra rumpens	-	3	-	-	*	*	-	-	-	-
ulna	3	4	-	-	*	3	*	5	2	4
vaucherae	-	-	-	-	-	-	-	*	-	-

* occurred at less than 1 percent.

TABLE VII. BENTHIC INVERTEBRATES - MIDDLE FORK FEATHER RIVER AND TRIBUTARIES
September 14-16, 1970

Taxa	STATIONS: Middle Fork Feather River (Flow 27.5) 2	7	9-I	10-II	18	-III	37-IV	Tributaries 15-T	19-T	26-T
FLATWORMS (TURBELLARIA)										
Planariidae	---	---	11	2	21	---	---	---	---	---
SEGMENTED ROUNDWORMS (OLIGOCHAETA)	2468	224	21	9	9	14	11	3	4	---
LEECHES (HIRUDINEA)	1	---	1	---	---	---	---	---	---	---
SCUDS (AMPHIPODA)										
Gammarus	1	---	---	---	---	---	---	---	---	---
Hyalella	3	1	5	3	---	---	---	---	---	---
CRAYFISH (ASTACIDAE)										
Pacifastacus	---	---	2	1	---	---	---	---	---	---
WATER MITES (HYDRACARINA)	3	---	---	---	---	1	---	---	1	---
INSECTS (INSECTA)										
Mayflies (Ephemeroptera)										
Ameletus	---	---	---	---	---	---	1	1	11	3
Baetis	7	4	231	215	95	157	174	88	31	28
Centroptilum	---	---	---	---	---	---	2	---	---	---
Cenygmula	---	---	---	---	---	---	---	---	10	2
Ephemerella delantala	---	---	---	---	---	---	---	1	---	---
Ephemerella doddsi	---	---	---	---	1	---	1	---	1	---
Ephemerella inermis/infrequens	---	---	---	5	4	1	---	8	8	1
Ephemerella micheneri/velmae	1	---	---	---	---	---	---	---	---	---
Ephemerella spinifera	---	---	---	---	---	---	---	1	---	5
Ephemerella tibialis	---	---	---	---	6	1	2	4	---	2
Heptagenia	---	---	---	---	---	---	1	1	---	---
Iron	---	---	---	---	2	2	15	1	---	2
Ironodes	---	---	---	---	---	---	---	---	1	2
Isonychia velma	---	---	---	5	3	2	2	---	---	---
Paraleptophlebia helena	1	---	2	7	8	---	2	7	1	---
Paraleptophlebia sp.	---	---	5	29	25	---	1	10	22	22
Rhithrogena	---	---	---	1	11	3	36	23	1	2
Siphlonurus	---	---	---	---	---	6	---	---	1	---
Tricorythodes	9	3	28	214	2	1	---	1	1	1

TABLE VII. BENTHIC INVERTEBRATES (Continued)

Taxa	STATIONS: Middle Fork Feather River (Flow 27.5) 2	7	9-I	10-II	18	-III	37-IV	Tributaries 15-T	19-T	26-T
Dragonflies (anisoptera)										
Ophiogomphus occidentis	---	---	1	---	---	---	1	---	---	---
Ophiogomphus severus	1	---	---	3	---	---	---	---	---	---
Damselflies (Zygoptera)										
Hyponeura	---	---	8	1	---	---	---	---	---	---
Moths (Lepidoptera)										
Parargyractis	---	---	5	1	---	---	---	---	---	---
Beetles (Coleoptera)										
Long-Toed Water Beetles (Dryopidae)										
Helichus	---	---	---	---	---	---	---	1	---	2
Riffle Beetles (Elmidae)										
Ampumixis	---	---	---	---	---	---	---	---	---	1
Optioservus	---	---	10	3	20	6	26	31	2	11
Ordobrevia	---	---	6	---	4	5	14	---	---	---
Rhizelmis	---	---	---	---	---	---	---	---	2	---
Zaitzevia	---	---	---	---	---	6	7	---	---	---
Water Pennies (Psephenidae)										
Eubrianax	---	---	---	---	---	---	1	---	---	---
Psephenus	---	---	---	---	1	---	1	---	---	---
True Flies (Diptera)										
Crane Flies (Tipulidae)										
Antocha	---	---	---	---	1	5	2	3	3	2
Dicranota	1	---	---	1	2	---	---	2	7	6
Hexatoma	---	---	---	---	10	8	5	4	3	3
Limonia	---	---	---	---	---	---	---	---	3	---
Ulomorpha	---	---	---	---	1	6	18	---	2	4
Moth Flies (Psychodidae)										
Telmatoscopus	---	---	---	---	---	---	---	---	---	3
Net-Winged Midges (Blephariceridae)	---	---	---	---	---	---	4	---	---	---
Black Flies (Simuliidae)	---	23	41	104	61	36	68	58	13	3
True Midges (Chironomidae)										
Brillia	2	---	---	---	---	---	---	---	---	---
Cardiocladius	---	---	3	4	16	17	2	32	11	---

TABLE VII. BENTHIC INVERTEBRATES (Continued)

Taxa	STATIONS: Middle Fork Feather River (Flow 2	7	9-1	10-II	18	27.5 -III	37-IV)	Tributaries 15-T	19-T	26-T
True Midges (Chironomidae (Continued)										
Chironomus (Cryptochironomus) sp.	---	14	---	---	---	---	---	---	---	---
Chironomus (Tribelos) sp.	---	30	6	3	---	15	---	1	---	1
Cladotanytarsus	---	4	---	---	---	---	---	---	---	---
Conchapelopia	1	1	13	52	8	18	2	6	42	5
Corynoneura	---	---	---	1	---	---	---	---	---	2
Cricotopus	28	272	19	2	14	9	29	86	131	---
Diamesa	---	---	---	---	4	25	26	11	41	---
Eukeifferiella	---	---	1	2	12	18	1	17	---	6
Metriocnemus	---	---	---	---	10	2	3	---	---	15
Micropsectra	---	---	---	---	9	---	---	19	---	153
Microtendipes	---	---	4	2	---	23	9	2	---	2
Nanocladius	---	---	---	---	---	---	35	---	8	27
Orthocladiinae in Nostoc sp.	---	---	---	---	---	---	2	---	---	---
Orthocladius	---	---	---	1	---	---	---	---	---	---
Polypedilum	---	2	---	---	27	12	33	7	17	43
Procladius	---	---	---	---	6	---	---	---	---	---
Prodiamesa	---	---	---	---	---	---	---	5	1	1
Pseudochironomus	1	---	---	---	---	4	---	1	44	---
Rheotanytarsus	---	---	---	---	---	18	---	85	8	1
Tanytarsus	6	2	16	18	---	18	2	---	6	---
Thienemanniella	---	---	---	---	2	---	---	1	---	---
Trichocladius	---	---	3	3	34	---	5	18	---	---
unidentified pupae	7	16	8	2	14	12	4	12	21	5
Biting Midges (Ceratopogonidae)										
Dasyhelea	---	---	---	---	---	1	---	---	---	---
Dance Flies (Empididae)										
Hemerodromia	1	---	---	---	---	---	4	---	---	2
Snipe Flies (Rhagionidae)										
Atherix variegata	---	---	---	---	---	2	---	---	---	---

TABLE VII. BENTHIC INVERTEBRATES (Continued)

Taxa	STATIONS: Middle Fork Feather River (Flow) 2	7	9-I	10-II	18	27.5 -III	37-IV	Tributaries 15-T	19-T	26-T
Horse Flies (Tabanidae)	1	---	---	---	---	---	---	---	---	---
House Flies (Muscidae)										
Lispe	3	1	---	---	---	---	---	---	7	---
Stoneflies (Plecoptera)										
Acroneuria californica	---	---	---	3	8	4	10	5	10	8
Acroneuria pacifica	---	---	---	---	---	1	8	---	---	---
Alloperla	---	---	---	---	---	---	3	---	---	---
Arcynopteryx aurea	---	---	---	---	---	---	---	---	2	---
Arcynopteryx barbara	---	---	---	---	---	---	1	---	2	2
Arcynopteryx (Skwala) sp.	8	---	1	17	10	2	11	8	9	3
Chloroperlinae (Alloperla, sp.)	1	---	---	---	2	1	---	---	5	7
Claassenia sabulosa	---	---	---	---	---	---	2	---	---	---
Isogenus	---	---	---	---	---	--1	---	---	---	---
Isoperla	---	---	---	1	1	---	---	---	---	---
Leuctra	---	---	---	---	---	---	---	---	2	7
Nemoura (Malenka) sp.	---	---	---	---	1	---	---	9	7	16
Pteronarcella regularis	---	---	---	---	1	---	---	1	---	2
Pteronarcys californica	---	---	---	---	---	---	1	---	---	---
Pteronarcys princeps	---	---	---	---	---	---	---	1	---	1
Caddisflies (Trichoptera)										
Anagapetus	---	---	---	---	---	---	---	12	11	12
Arctopsyche	---	---	---	---	1	1	5	1	1	8
Cheumatopsyche	---	---	228	103	69	88	62	203	1	---
Ecclisomyia	---	---	---	---	---	---	---	1	---	---
Glossosoma	---	---	1	---	1	2	3	---	---	7
Helicopsyche	---	---	---	---	---	1	41	1	---	---
Hydropsyche	1	2	342	54	38	42	59	156	40	116
Hydroptila	---	1	---	---	3	1	17	---	18	---
Lepidostoma	---	---	---	---	209	103	1	324	71	5
Oecetis	---	---	---	---	19	18	8	1	---	---
Polycentropus	---	---	---	---	---	---	---	---	1	---
Rhyacophila	---	---	1	1	4	2	2	3	1	---
Wormaldia	---	---	---	---	66	6	25	10	15	17

TABLE VII. BENTHIC INVERTEBRATES (Concluded)

Taxa	STATIONS: Middle Fork Feather River (Flow) 2	7	9-I	10-II	18	27.5-III	37-IV	Tributaries 15-T	19-T	26-T
Alderflies (Sialidae)										
Sialis	---	---	---	---	1	1	---	1	---	---
Dobsonflies (Corydalidae)										
Dysmicohermes crepusculus	---	---	---	---	---	---	---	---	1	1
SNAILS (GASTROPODA)										
Lung Snails (Pulmonata)										
Ferrissia	---	1	---	---	---	---	---	---	---	---
Gyraulus	1	---	---	---	---	---	---	---	---	---
Lanx	---	---	2	---	---	---	---	---	---	---
Lymnaea	2	---	---	---	---	---	---	1	---	---
Physa	1	---	---	---	---	1	---	---	---	---
Gill Snails (Prosobranchia)										
Goniobasis	---	---	---	---	---	---	1	---	---	---

	STATIONS: 2	7	9-I	10-II	18	27.5-III	37-IV	15-T	19-T	26-T
total enumerated	2,560	601	1,025	873	895	711	820	1,289	662	580
fraction of sample enumerated	1/8	1/32	1/8	1/16	1/16	1/8	1/6	1/8	1/8	1/16
computed total in sample	20,480	19,232	8,200	13,968	14,320	5,688	4,920	10,312	5,296	6,960
number of field screenings	10	5	8	10	10	10	10	8	5	5
stream area sampled in sq. ft.	40	20	32	40	40	40	40	32	20	20
total number of organisms per sq. ft.	512	962	257	350	358	143	123	323	265	348
total number of organisms identified	768	433	654	877	895	780	847	1,173	769	588
number of taxa	25	16	29	33	48	47	55	50	49	47

TABLE VIII. BENTHIC INVERTEBRATES - MIDDLE FORK FEATHER RIVER AND TRIBUTARIES
(PERCENT OCCURRENCE BY MAJOR GROUPS) September 1970

Taxonomic Group	STATIONS: Middle Fork Feather River (Flow ⟶) 2	7	9-I	10-II	18	27.5-III	37-IV	Tributaries 15-T	19-T	26-T
Flatworms (Turbellaria)	---	---	1.1	.2	2.4	---	---	---	---	---
Segmented Roundworms (Oligochaeta)	96.4	37.2	2.0	1.0	1.0	2.0	1.4	.2	.6	---
Leeches (Hirudinea)	.05	---	.1	---	---	---	---	---	---	---
Scuds (Amphipoda)	.1	.2	.5	.4	---	---	---	---	---	---
Crayfish (Astacidae)	---	---	.2	.1	---	---	---	---	---	---
Water Mites (Hydracarina)	.1	---	---	---	---	.1	---	---	.1	---
Insects (Insecta)										
Mayflies (Ephemeroptera)	.8	1.2	25.9	54.5	17.5	24.2	28.7	11.4	12.9	11.9
Stoneflies (Plecoptera)	.3	---	.1	2.4	2.5	1.2	4.4	1.9	5.7	7.9
Caddisflies (Trichoptera)	.05	.5	55.7	18.1	45.9	37.1	27.3	55.1	23.9	28.6
Alderflies (Sialidae)	---	---	---	---	.1	.1	---	---	---	---
Dobsonflies (Corydalidae)	---	---	---	---	---	---	---	.1	.1	.2
Dragonflies (Anisoptera)	.05	---	.1	.4	---	---	.1	---	---	---
Damselflies (Zygoptera)	---	---	.8	.1	---	---	---	---	---	---
Moths (Lepidoptera)	---	---	.5	.1	---	---	---	---	---	---
Beetles (Coleoptera)	---	---	1.6	.4	2.8	2.3	6.0	2.5	.6	2.4
True Flies (Diptera)										
Crane Flies (Tipulidae)	.05	---	---	.1	1.5	2.6	3.0	.7	2.9	2.5
Net-Winged Midges (Blephariceridae)	---	---	---	---	---	---	.5	---	---	---
Moth Flies (Psychodidae)	---	---	---	---	---	---	---	---	---	.5
Black Flies (Simuliidae)	---	3.8	4.0	11.9	6.8	5.1	8.3	4.5	2.0	.5
True Midges (Chironomidae)	1.8	56.7	7.2	10.3	19.5	24.8	19.7	23.5	50.1	45.2
Biting Midges (Ceratopogonidae)	---	---	---	---	---	.1	---	---	---	---
Dance Flies (Empididae)	.05	---	---	---	---	---	.5	---	---	.3
Snipe Flies (Rhagionidae)	---	---	---	---	---	.3	---	---	---	---
Horse Flies (Tabanidae)	.05	---	---	---	---	---	---	---	---	---
House Flies (Muscidae)	.1	.2	---	---	---	---	---	---	1.1	---
Snails (Gastropoda)	.1	.2	.2	---	---	.1	.1	.1	---	---
Total Percent	100.00	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0
Number of Organisms	2,560	601	1,025	873	895	711	820	1,289	662	580

material present. Their presence indicates a high stream bottom concentration of organic matter (detritus and silt were visually observed during the sampling). It also implies a continuing deposition of organic material, since replenishment of its food supply is necessary for development and maintenance of such high populations.

Although environmental factors may modify invertebrate community structure, a clean and swift flowing stream normally will support an invertebrate community consisting of immature insects dominated by the combined numbers of mayflies, stoneflies, and caddisflies. Under the influence of organic pollution the relative abundance of these groups is reduced. There is a corresponding increase in the tolerant groups such as segmented roundworms (Mackenthun, 1969).

The invertebrate population densities or number of organisms per square foot are presented in Table VIII and Figure 6. The number of organisms per square foot at Summit School (512) was almost doubled at Beckwourth (962). These figures indicate enriched conditions in the Sierra Valley. The stations above Portola, Delleker, and the tributary streams (Sulfur Creek, Graeagle Creek, and Long Valley Creek) show moderately high densities (257-358), indicating an abundant food source and a moderately high level of enrichment. Only the Sloat and Milsap Bar stations (27.5-III, 37-IV) supported the low benthic-invertebrate population densities normally associated with a clean, mountain stream (143 and 123).

The diversity of invertebrates obtained per station was low at the Sierra Valley stations, but increased at successive downstream stations, and attained its highest value at Milsap Bar (Figure 7). There were 25 species at Summit School and 16 at Beckwourth. Diversity steadily increased from 29 species at Portola to 55 species at Milsap Bar, indicating improving water quality as the River traveled downstream (Wilber, 1969). The tributaries Sulfur, Graeagle, and Long Valley Creeks supported highly diverse populations numbered at 50, 49, and 47, respectively.

At Beckwourth, invertebrate density was high, but diversity low. This occurrence is a classic response of invertebrate communities to water pollution (Hynes, 1960). The very high diversity of invertebrates and low population densities obtained at Sloat and Milsap Bar follows the classic response of invertebrate communities to clean water of high quality.

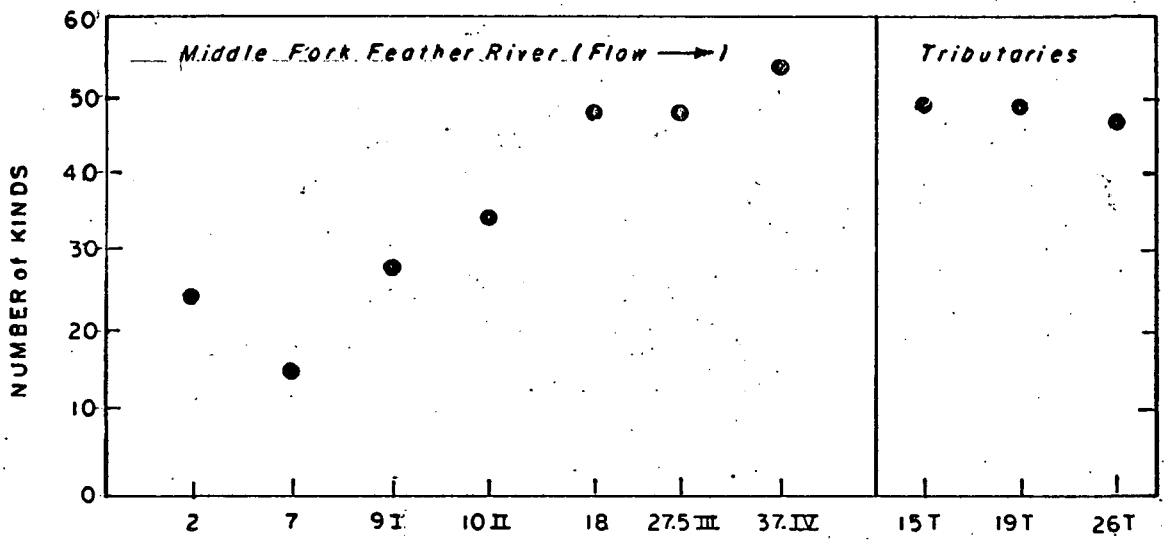

Figure 6. NUMBER OF KINDS OF BENTHIC INVERTEBRATES

MIDDLE FORK FEATHER RIVER

ENVIRONMENTAL PROTECTION AGENCY
REGION IX

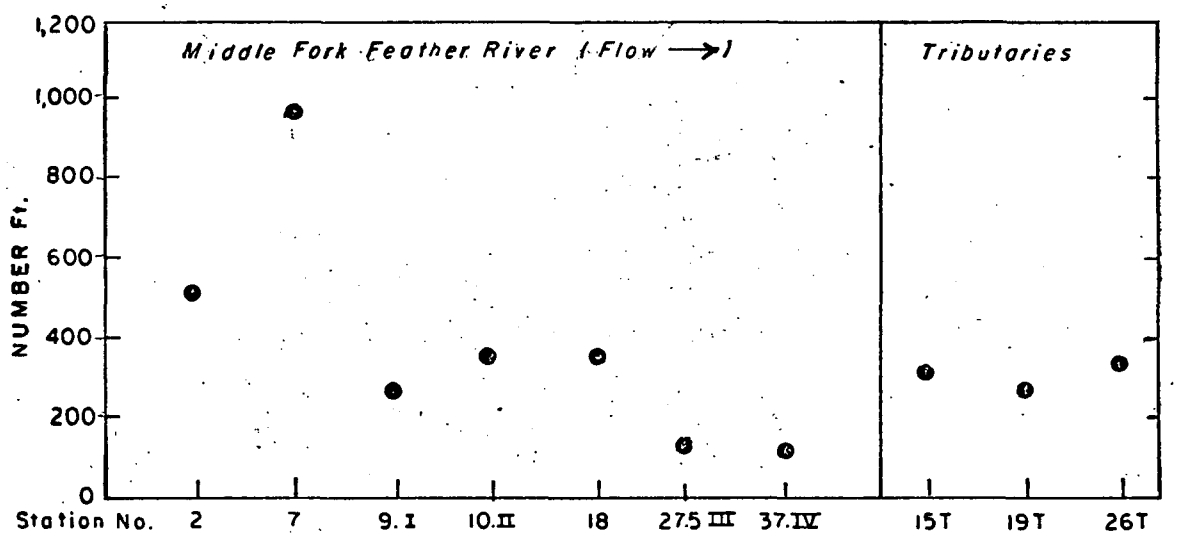

Figure 7. NUMBER OF INVERTEBRATES PER SQUARE FOOT

MIDDLE FORK FEATHER RIVER

ENVIRONMENTAL PROTECTION AGENCY
REGION IX

MICROBIOLOGY

The microbiological results of this study are presented in Table IX. Total coliform levels range from 350- 2700/100 ml; fecal coliforms vary from 20-380/100 ml. Although the total coliform counts were high for many stations, accompanying high fecal coliform levels (200/100 ml) were noted only at 5-T, tributary to Middle Fork Feather River off Marble Lane; 15-T, Sulfur Creek near mouth; and 18, Middle Fork Feather River above Graeagle Creek. Since only one day's sample was gathered for each station, it is impossible to say whether or not the water exceeds the EPA-recommended limits for primary-contact recreation, i.e. five samples over 30-day period shall not exceed a log mean of 200 fecal coliforms/100 ml. In general, the high total coliform levels seem due to soil organisms of non-fecal origin.

FURTHER NOTES

The results of this study have provided some background data on the biology and microbiology of the Middle Fork Feather River area. It has been reported that dense submerged weed growths are present in Lake Davis, a new reservoir, and that privately-owned lands upstream of the reservoir and similar lands in Sierra Valley are being sold for recreational home sites. Limited county planning for these summer residences has not included collected wastewater-disposal facilities. Therefore, individual septic systems are still being used. In the spring, the impacts of large crowds of fishermen (3000-to-5000 per day) at Davis Lake and similar numbers at Frenchman Reservoir have created wastewater-disposal problems. It is suspected that this is contirbuting to the early eutrophication of the basin. To temporarily check this problem, Plumas County has placed a moratorium on new recreational tract developmnets. However, additional observations and discussions of proposed development around the headwaters and its effect on water quality in the Recreation and Scenic Zones of the River may be useful.

TABLE IX

BACTERIAL RESULTS
MIDDLE FORK FEATHER RIVER
September 1970

Station Number	Total Coliform per 100 ml	Fecal Coliform per 100 ml
1-T	760	33
5-T	1600	370
7	2700	100
9-I	1600	33
10-II	1600	33
13	1600	130
15-T	1600	380
18	1600	215
19-T	1280	33
20	2700	67
21-T	1460	63
22	1600	33
23-T	350	33
26-T	1500	33
27.5-III	1600	78
28	1600	33
32	800	20
37-IV	1600	33

LITERATURE CITED

American Public Health Association. Standard Methods for the Examination of Water and Sewage, 12th Edition. New York, American Public Health Association, 1965. 769 pp.

Bain, Richard C. Algal Growth Assessments by Fluorescence Techniques. Berkeley, California, Proceedings of the Eutrophication-Biostimulation Workshop, June 1969.

Hynes, H. B. N. The Biology of Polluted Waters. Liverpool University Press, 1960. 202 pp.

Mackenthun, Kenneth M. The Practice of Water Pollution Biology. USDI, FWPCA, Division of Technical Support, 1969. 281 pp.

Pennak, Robert W. Freshwater Invertebrates of the United States. Ronald Press Company, 1953. 769 pp.

U.S. Department of the Interior, Federal Water Quality Administration. "Water Quality and Aquatic Biology East Fork Kaweah River, Mineral King Area, California." August 1969.

Wilber, Charles G. The Biological Aspects of Water Pollution. Charles G. Thomas, 1969. 296 pp.