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STREAM SURVEY

TOMICHI CREEK at CLARKS' RANCH

1987-88

by Michael L. Mancini
Western State College
Gunnison, Colo.

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INTRODUCTION

The stream survey is located on Tomichi Creek approximately 3 km from the confluence of the Cochetopa and the Tomichi Creeks, approximately 12 km east of Gunnison, Colorado. The purpose of the qualitative survey is to evaluate the chemical, physical, biotic conditions of the creek, and to evaluate it's potential as a cold water fishery. Areas of future concern are elaborated. An intensive survey of the Tomichi drainage by Perry (1973) indicates the lower part of the stream is agriculturally enriched and displays simplified insect communites characteristic of a degraded system. A sample site on Clarks' ranch in the study by Perry (1973), did not show the same large impacts on insect communities. The nutrient and alkalinity values were high, but diversity of insect communities had not decreased. If the aquatic habitat at Clark's ranch has been degraded, insect diversites will be low, and/or water chemical analysis and physical streambed characteristics will indicate an impacted system. The survey includes water chemical analysis, turbidity, and physical stream characteristics of embeddedness, percentage of pool area, bottom composition, streambank stability and steambank cover. Biological components analyzed include fecal coliform counts, aquatic insect diversity analysis, and fish growth rates as determined by scale analysis and back-calculation. The sampling was made in the summer of 1987, with limited sampling in the fall of 1987 and spring 1988.

METHODS

Chemical analysis of the water was provided by the Colorado State University Soil Testing Lab (Fort Collins) in June and October including Ca,Mg,Na,K.P,Al,Fe,Mn,Cu,Zn,Ni,Mo,Cd,Cr,Ba using EPA Method 200.7 for trace element analysis. Measurements for NH_4 were made using EPA Method 350.1. Levels of CO_3 and HCO_3 were distinguished using Standard Methods for the Examination of Water and Wastewater, Method 403. Sulfate,Cl,NO_3,F were evaluated using Standard Methods of Water and Wastewater, Method 429. Arsenic and Se were measured using hydrite generation method described in Soil Analysis, second edition (1982). Ortho and Total phosphates were measured at the C.S.U Laboratory using Standard Methods of Water and Wastewater, Method 424F. Samples were taken at sample site one, Cochetopa Creek above the confluence with the Tomichi, at sample site four and seven. On site measurements of dissolved oxygen, temperature, conductivity and pH were made using a portable Hydrolab Surveyer Two (Hydrolab Corp., Austin, Texas) at four transects for each sample site during summer, fall and spring samplings. In stream flow for both creeks was monitored in June, July, October and March (Windell 1980). Turbidity levels were measured three times during the summer at the seven sample sites using a turbidity meter model DTR 100 (H.F. Instruments, Fort Myers, Fl.). Embeddedness, percent of pool composition, bottom composition, stream side cover and streambank stability were surveyed at the twenty eight transects in August, 1987 (Platts et al.1983).Two Surber samples were taken at each transect during the summer of 1987, during a ten day period in July. Diversity indices of the aquatic invertebrates for each sample were calculated using a sequential comparison index method (Cairns et al.1968). Scales of trout caught by fisherman were analyzed using back-calculation methods from annuli radii to determine growth rate of sampled fish (Moyle et al.1982). Fecal coliform levels were measured in June, July, August, October and March using Standard Methods of Water and Wastewater Analysis, multiple tube technique.

SITE DESCRIPTION

The Clarks' ranch section of Tomichi Creek is located in an agricultural community at 2380 m above sea level, 9.6 km east of Gunnison, Colorado in Gunnison County in southwestern Colorado. The creek flows for approximately 11 km before confluence with the Gunnison River at the town of Gunnison, Colorado (Perry 1973).

Seven sample sites were selected (Fig.1): sample site one is located west of the bridge on Colorado Highway 114 crossing the creek. Sample site two is located approximately 100 m below the confluence of Cochetopa and Tomichi Creeks. Sample site three parallels U.S. Highway 50, approximately .4 km east of the house. Sample site four is located west of the house and barn. Sample site five is located at the bridge crossing the creek at the west end of the property. Sample site six is located east of the water diversion at the west side of the property and site seven is located below the water diversion inside the west property line. The seven sites were selected to systematically sample the 2.9 km of creek on the the ranch. Four transects per site were marked. Transect one for each site is 15 m upstream from the sample site marker. Transect two is located at the sample site marker and transects three and four are located 15 m and 30 m below the site marker, respectfully. The area surrounding the creek is wetlands, pastures and meadows used for ranching. The dominant vegetation surrounding the creek is primarily sedges and rushes, with willow present on some sections of the creek.

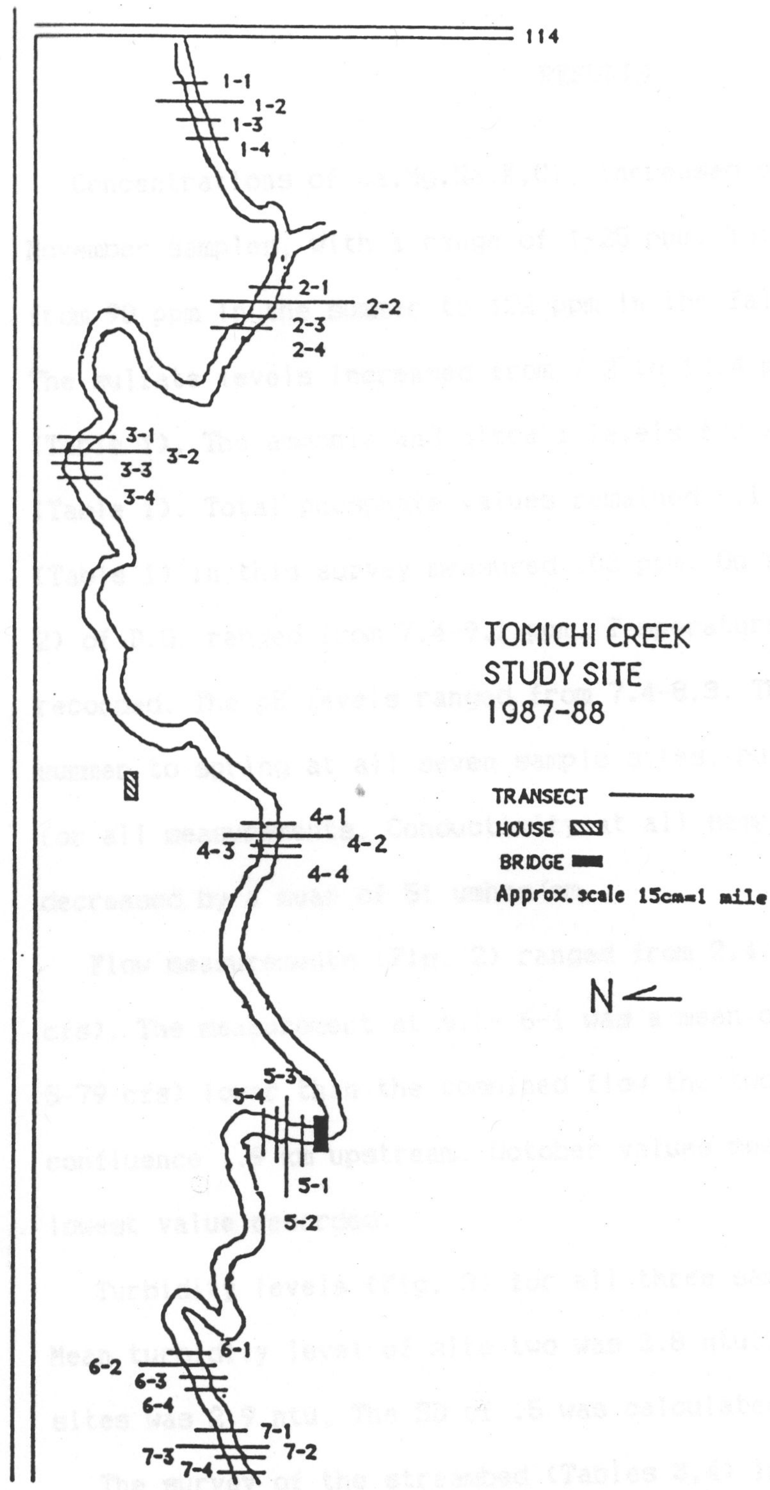

Figure 1. Sample site locations at Clarks' ranch

RESULTS

Concentrations of Ca,Mg,Na,K,Cl, increased slightly from June to November samples, with a range of 1-25 ppm. Total alkalinity increased from 98 ppm in the summer to 122 ppm in the fall sample (Table 1). The sulfate levels increased from 7.2 to 13.4 ppm from summer to fall (Table 1). The ammonia and nitrate levels for all samples measured <1ppm (Table 1). Total phosphate values remained <.1 ppm. Ortho-phosphates (Table 1) in this survey measured .03 ppm. On site measurements (Table 2) of D.O. ranged from 7.4-9.1 ppm. Temperatures from 0-17.6 ^{o}C were recorded. The pH levels ranged from 7.4-8.3. The pH decreased from summer to spring at all seven sample sites, but remained 7.4 or above for all measurements. Conductivity at all sample sites, except site two, decreased by a mean of 51 umhos/cm.

Flow measurements (Fig. 2) ranged from 2.4 m^3 to 17.5 m^3 (81-585 cfs). The measurement at site 6-1 was a mean of 1.2 m^3(39.8 cfs, range 5-79 cfs) lower than the combined flow the two creeks above their confluence 1.9 km upstream. October values measured 2.4 m^3(81 cfs), the lowest value recorded.

Turbidity levels (Fig. 3) for all three sample runs varied < 1.2 ntu. Mean turbidity level of site two was 3.8 ntu.The mean of the all sample sites was 2.9 ntu. The SD of .5 was calculated for all sites.

The survey of the streambed (Tables 3,4) indicates sample site four has the highest fine sediment rating. Amounts of rubble/gravel at sites 1,2,3,5 and 7 are high. Embeddedness rated highest at sample sites four and seven. Both sites are rated at >75% of bottom substrate covered with fine sediment. Embeddedness except for sample site five, indicated that

Table 1. Water chemical analysis by C.S.U. soil lab.

	mg/l 6/23	mg/l 11/1		mg/l 6/23	mg/l 11/1
Ca	24.1	24.5	CO_3	<1.0	<1.0
Mg	4.9	7.7	HCO_3	97.1	122.0
Na	4.5	8.4	SO_4	7.2	13.4
K	1.9	2.5	Cl	2.0	2.4
Total P	<.1	<.1	NO_3	<.4	<.1
Al	<.1	<.1	F	.30	.32
Fe	.04	.03	NH_4	<.01	.03
Mn	<.01	.02	Ortho P	.03	.03
Cu	<.01	<.01	As	.003	.003
Zn	<.01	<.01	Se	.002	.002
Ni	<.01	<.01	Ba	.02	.02
Mo	<.01	<.01	Cr	<.01	<.01
Cd	<.01	<.005			

Table 2. On site physical measurements.

Sample Site	Date	Dissolved Oxygen	Temperature °Celcius	Conductivity µmhos/cm	PH
1	7/31	7.6	17.4	273	8.3
	10/10	9.0	6.3	276	7.9
	3/31	5.7	.3	243	7.5 *
2	7/31	7.7	17.6	227	8.3
	10/10	9.1	6.2	270	8.0
	3/31	6.6	.1	219	7.7
3	7/31	7.8	16.9	286	8.3
	10/10	9.1	5.8	270	7.9
	3/31	6.6	0	229	7.8
4	7/31	7.7	16.6	287	8.3
	10/10	8.9	5.5	270	8.0
	3/31	8.0	0	229	8.0
5	7/31	7.6	16.3	286	8.2
	10/10	9.1	5.5	270	8.0
	3/31	8.1	0	230	7.5
6	7/31	7.6	16.2	287	8.2
	10/10	9.1	5.4	270	8.0
	3/31	8.3	0	231	7.4
7	7/31	7.4	16.1	286	8.1
	10/10	8.9	5.8	269	7.9
	3/31	8.5	.1	230	7.6 *

Values represent the mean of four samples
*lab measurement

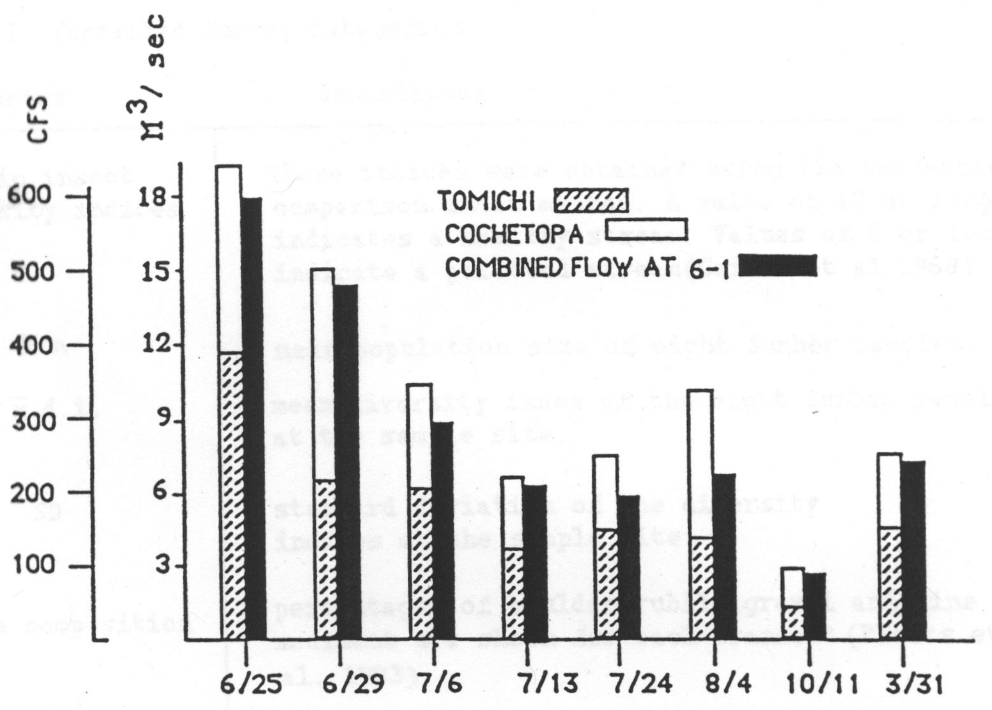

Fig.2 Streamflow records of Tomichi and Cochetopa Creeks.

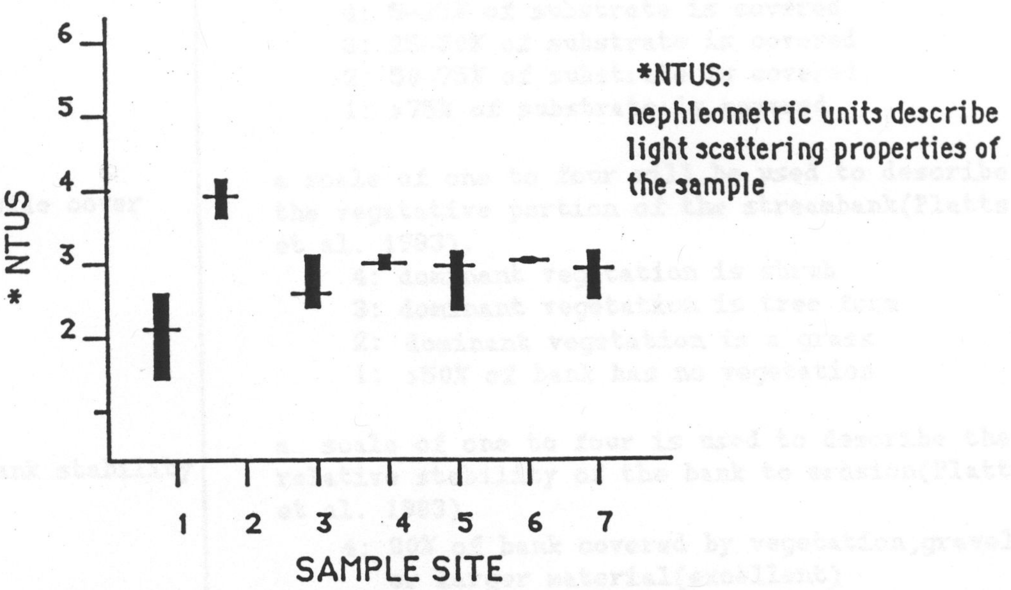

Figure 3.Turbidity mean and ranges from three samples.

Table 3. Streambed Survey categories

Categories	Description
Aquatic insect diversity indices	These indices were obtained using the sequential comparison index method. A value of 12 or larger indicates a healthy stream. Values of 8 or less indicate a polluted stream(Cairns et al.1968).
$\bar{x}$ n	mean population size of eight Surber samples
$\bar{x}$ d.i.	mean diversity index of the eight Surber samples at the sample site.
SD	standard deviation of the diversity indices at the sample site.
Bottom composition	percentages of boulder,rubble,gravel and fine sediment are shown for each transect (Platts et al. 1983)
% Pool area	amount of pool area/transect. 50% is considered ideal for trout habitat(Platts et al. 1983).
Embeddedness	the degree to which bottom substrate is covered by fine sediment. A scale of one to five is used (Platts et al. 1983). A scale of one to five is used: 5: <5% of substrate is covered 4: 5-25% of substrate is covered 3: 25-50% of substrate is covered 2: 50-75% of substrate is covered. 1: >75% of substrate is covered
Streamside cover	a scale of one to four will be used to describe the vegatative portion of the streambank(Platts et al. 1983). 4: dominant vegetation is shrub 3: dominant vegetation is tree form 2: dominant vegetation is a grass 1: >50% of bank has no vegetation
Streambank stability	a scale of one to four is used to describe the relative stability of the bank to erosion(Platts et al. 1983) 4: 80% of bank covered by vegetation,gravel or larger material(excellent) 3: 50-79% of bank is covered(good) 2: 25-49% of bank is covered(fair) 1: <25% of bank is covered(poor)

Table 4. Streambed survey of categories from table three.

Transect	Aquatic insect Diversity index		$\bar{x}$ n $\bar{x}$ d.i. SD	Bottom Composition Percentages Bldr.	Rub.	Grv.	Sed..	% Pool	$\bar{x}$	Embed.	$\bar{x}$	Stream side Cover		$\bar{x}$	Bank Stab.		$\bar{x}$
1-1	6.7	7.6		6	82	—	12	75		1		2	3		4	2	
1-2	5.4	6.7	34.2	—	73	19	8	95	73.8	3	2.5	2	1	2.4	4	1	2.4
1-3	10.1	8.5	7.7	—	59	32	9	45		2		2	3		4	1	
1-4	8.9	7.4	1.5	—	78	12	10	80		4		4	2		1	2	
2-1	8.6	2.1		—	69	3	28	15		2		2	2		3	2	
2-2	6.4	9.0	32.1	—	51	—	49	30	35.0	4	2.5	2	2	2.3	1	3	1.9
2-3	9.0	9.1	7.4	—	65	24	11	85		2		2	4		1	1	
2-4	9.3	5.1	2.6	—	61	23	16	100		2		2	4		3	1	
3-1	8.8	10.2		—	61	31	8	80		2		3	4		2	3	
3-2	9.8	7.7	55.4	—	80	—	20	30	61.3	2	2.5	3	2	3.0	4	1	
3-3	7.0	4.7	8.0	—	76	—	24	75		2		4	2		2	1	1.9
3-4	8.5	6.9	1.8	—	75	12	13	60		4		3	3		1	1	
4-1	5.6	3.7		—	57	—	43	45		1		2	2		2	2	
4-2	2.6	8.6	18.9	—	48	21	31	78	80.0	1	1.0	2	2	2.3	1	1	
4-3	3.2	5.5	4.6	—	18	35	47	100		1		2	2		1	1	1.8
4-4	4.3	3.3	1.9	—	23	13	64	100		1		2	4		2	4	
5-1	3.0	7.6		—	44	53	3	5		4		2	1		1	3	
5-2	2.4	3.0	22.9	—	81	—	19	85	55.0	3	3.5	4	1	2.5	4	3	2.9
5-3	6.0	4.8	5.1	—	88	6	6	100		3		4	4		4	3	
5-4	5.3	8.6	2.3	—	75	16	9	30		4		2	2		3	2	
6-1	3.4	6.0		—	96	—	4	100		1		2	2		2	3	
6-2	3.5	3.3	18.4	—	63	30	7	100	95.0	2	2.3	4	2	2.6	2	1	1.9
6-3	4.2	8.5	5.1	1	37	13	49	100		3		3	2		1	1	
6-4	4.9	6.6	1.9	3	49	6	42	80		3		4	2		4	1	
7-1	5.6	4.0		—	75	—	25	100		1		4	1		3	4	
7-2	7.3	5.5	10.5	—	95	—	5	80	92.5	1	1.0	1	4	2.0	2	4	3.0
7-3	5.3	5.5	4.8	—	62	19	19	90		1		1	1		3	4	
7-4	1.5	2.5	1.9	--	56	19	25	100		1		2	2		2	2	

>49% of the bottom substrate is covered by silt. Percentage of pool area per transect indicates sample site three and five had values closest to 50%. Sites one, four, six and seven showed values of >73 % pool area. Streamside cover for trout rates highest at sample site three.The remaining sample site values range from 2.0-2.6. Bank stability rates "poor to fair" at sample sites two, three, four and six. Sample sites one, five and seven rates "fair to good".

Aquatic insect diversity values at sample site one, two and three have the highest mean values; 7.7, 7.4, and 8.0 respectfully. Site three has the highest calculated mean diversity index of 8.0. The diversity index at sample sites four, five and six range from 4.6 to 5.1. The mean diversity for all sites sampled is 6.1 and a standard deviation 1.5. Relative densities of aquatic insects per Surber sample shows: 41 individuals per sample were collected at sites one, two and three, 20 individuals at sites four,five and six and 10 individuals at site seven.

Scale survey results (Fig. 4) of twenty sampled fish indicate a growth rate of 11.2 cm from age 1+ to 2+ years, and 4.85 cm growth from age 2+ to 3+ years. The mean growth rate for brown trout up to three years old in this survey is 8.0 cm/year.

Fecal coliform bacterial levels (Fig. 5) ranges from 4->2,400 per 100 ml with a mean of 369/100 ml.

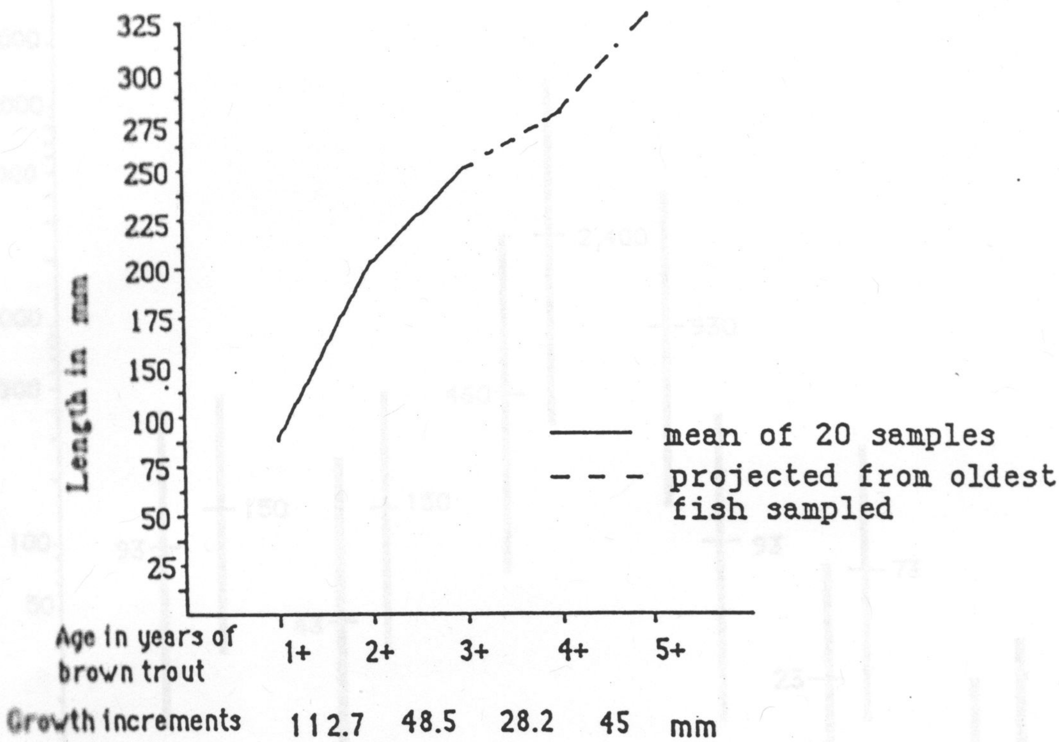

Figure 4. Growth rates calculated from scale samples

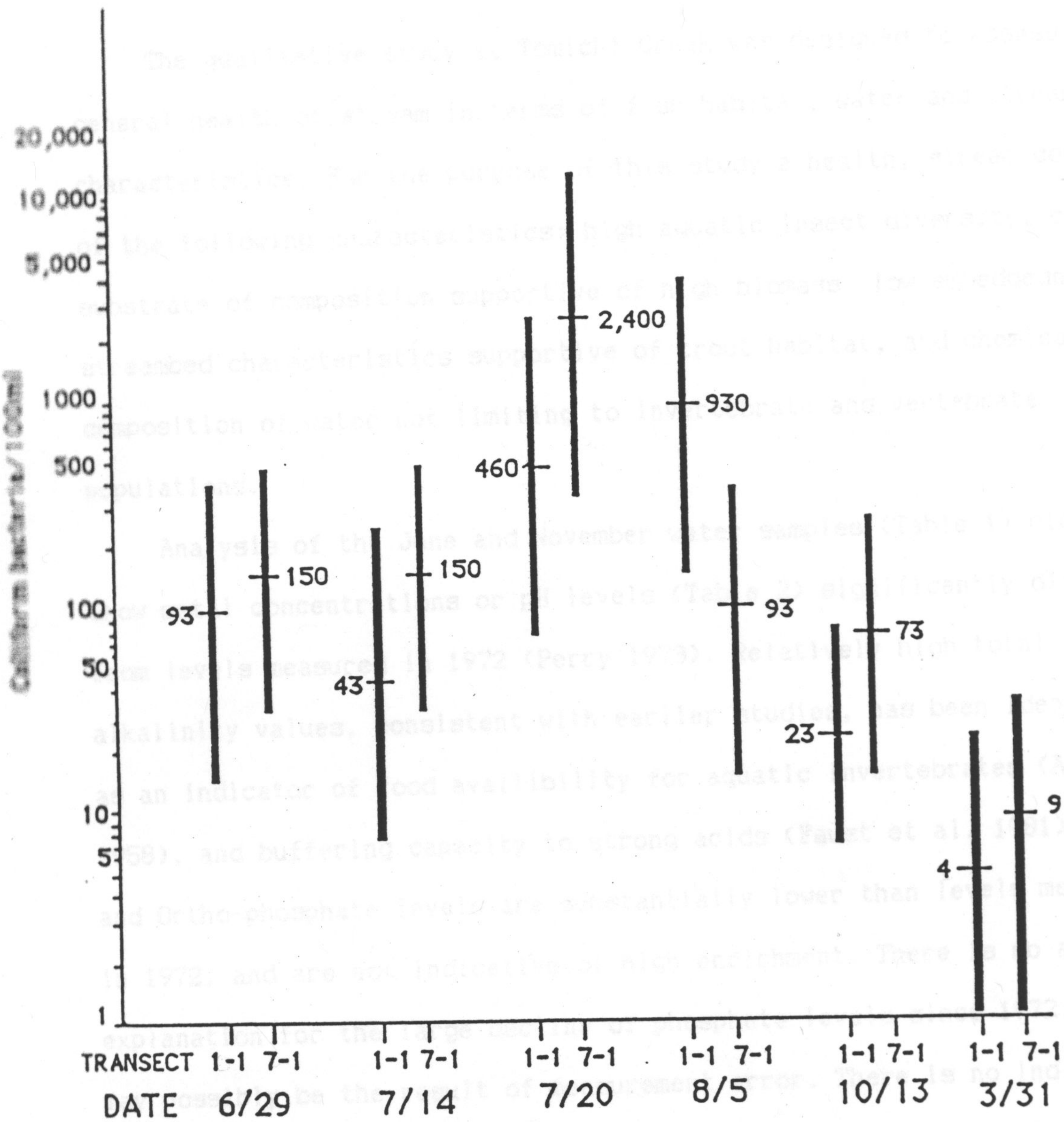

Figure 5. Most probable number of coliform bacteria/100 ml and range at 95% confidence level.

DISCUSSION

The qualitative study at Tomichi Creek was designed to assess the general health of stream in terms of fish habitat, water and streambed characteristics. For the purpose of this study a healthy stream consists of the following characteristics: high aquatic insect diversity, bottom substrate of composition supportive of high biomass, low embeddedness, streambed characteristics supportive of trout habitat, and chemical composition of water not limiting to invertebrate and vertebrate populations.

Analysis of the June and November water samples (Table 1) did not show metal concentrations or pH levels (Table 2) significantly different from levels measured in 1972 (Perry 1973). Relatively high total alkalinity values, consistent with earlier studies, has been identified as an indicator of food availibility for aquatic invertebrates (Armitage 1958), and buffering capacity to strong acids (Faust et al. 1981). Total and Ortho-phosphate levels are substantially lower than levels measured in 1972, and are not indicative of high enrichment. There is no apparent explanation for the large decline of phosphate levels since 1972, and may possibly be the result of measurement error. There is no indication in concentrations, invertebrate richness or pH levels, that metals or non metals are at levels to limit biotic components of the stream. The survey of the chemical composition of the water would be indicitive of a healthy stream. Temperature and dissolved oxygen levels are not limiting to trout populations (Table 2). Conductivity (Table 2) was decreased and turbidity levels (Fig. 3) increased by the Cochetopa entrance above site two. Conductivity levels are slightly higher than average conductivity of Gunnison area waters measured in 1977 (Rumburg et al.1978). Turbidity levels impact on the system would be clarified through plankton studies (Hynes 1970) however, there is no indication of growth rates calculated from scale survey of brown trout to indicate critical turbidity levels for trout.

Instream flow decrease measured from the upper and lower ends of the property, is not large enough to impact trout populations. The amount of flow into wetland areas and diversion for agriculture is unknown (Fig. 2). Large changes in the flow of both creeks could be seen during a 24 hour period. The measurements of this study were designed to determine approximate range of flow, but lack precision in velocity measurement for determining minimum flow levels. Records of flow of higher accuracy are needed as useage and demand on water supplies increase (Grover et al. 1966).

Low aquatic insect diversity values correspond to areas high in fine sediment, highly embedded or both (Tables 3,4). As bottom composition increases in fine sediment, insect diversity values decrease (Wiederholm 1984). Bedrock, gravel and rubble support increased biomasses (Hynes 1970). Although not indicated by the scale used, site seven has the thickest layer of sediment of any transect. Silt and fine sediment may significantly impact habitat chemical and physical composition of a stream (Minshall 1984). The survey indicates sample sites four and seven have the poorest substrate characteristics to support biomass. Relatively high pertanges of rubble and gravel at sites one, two, three, and five provide subtrate characteristics conducive to high productivity, high invertebrate diversity and provides habitat for successful reproduction of trout.

Streamside cover (Tables 3,4) rated highest at site three, and was extensive above sites three and five, providing the best trout cover on this section of creek. Site three and between sites four and five, represent areas currently rated highest as trout habitat by this survey. Low streambank stability at sites two three, four and six are decreasing available habitat and cover for trout populations. Stream habitat improvement can improve trout biomass, increase populations of nontargeted organisms for a relative low cost using readily available materials (Burgess 1985). Fish scale analysis indicates an 8 cm/year growth rate for fish up to two years in age (Fig. 4). Streambank stability is a major concern at site four (Table 4). A scale was not used to evaluate grazing impact when initial observations indicated grazing was extensive over much of the streambank. Grazing impact can be observed in outslope angles of streambank and decreasing undercut banks for trout habitat (Platts 1981). Between sites three and four approximately 4 m of vertical streambank next to U.S.Highway 50 is composed of fine sediment perpendicular to flow for approximately 41 m. High streambank erosion was observed in the spring and fall samplings. Bank stability and streamside cover have recovered in one to four years in studies done on exclosure of livestock from damaged streams, however they have shown they may be degraded again in less than two months (Duff 1979).

Aquatic insect diversity values are substantially lower between sites four and seven than between sites one and three (Tables 3,4). Sites one through three do not differ significantly from values measured above and below the Cochetopa in 1972, which showed this section to be mildly enriched (Perry 1973). The lowest calculated diversity values for insects corresponds to the highest embeddedness values. Riffle communities are known to be very sensitive to enrichment (Hawkes 1979), yet the riffle communities in the survey did not show substantially lower diversities. This may indicate insufficent data was collected for accurate diversity analysis or possibly may be the result of difficult accesss to the water by livestock. The cause of the low diversity values at sample site four through seven is undetermined from this study. The mean diversity value calculated for site seven is 4.8 which is very similar to sites four,five and six. Sample site seven was located just below a water diversion constructed using a bulldozer. The impact of this diversion on insect populations at site seven has effected population size more than species richness. Aquatic insect diversity values are know to be sensitive indicators of productivity and stability. Insect diversity and densities indicates the lower section of the creek below the house is degraded more than sites one, two, and three which would be considered only mildly degraded.

High bacterial levels corresponded to the high grazing periods (Fig. 5). The degree, if any, of this impact on insect diversity and trout populations was not determined. High fecal levels were not measured continually. The lack of constantly high coliform levels and relatively high D.O. levels, are not indicative of high levels of degradation due to fecal contamination. Fecal coliform levels are similar to average values measured in 1977 for Gunnison area waters (Rumburg et al. 1977)

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