RECONNAISSANCE SURVEY OF BLUEWATER CREEK, CIBOLA COUNTY
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INTRODUCTION

In July 1983, the Surveillance and Standards Section conducted a reconnaissance survey of Bluewater Creek from Bluewater Dam to the mouth of Bluewater Canyon (Figure 1). During this two-day study, stream flow, biological, and water quality data were collected in order to evaluate the possible impact of a proposed wastewater treatment plant at Bluewater Lake State Park on the water quality of Bluewater Creek. The proposed package plant would provide secondary treatment and discharge 10,000 gallons per day of effluent into an unnamed arroyo which empties into Bluewater Creek. Bluewater Creek is classified and protected by numeric standards for the uses of high quality coldwater fishery and domestic water supply (NMWQCC 1981). Effluent discharged to this stream could degrade its water quality and thus interfere with these designated uses.

SAMPLING SITES

Two stream sites were sampled: (1) one mile downstream from the dam at the mouth of the arroyo and (2) seven miles downstream from site No. 1 at the mouth of Bluewater Canyon. At the upstream site the creek has incised a narrow canyon approximately 35 m in width. The stream ranged in width from 3 to 6 m and in depth from 15 to 60 cm, and had a discharge of

0.671 m^3 sec^{-1} (23.7 cfs). The stream bottom consisted of gravel, rubble and boulders. Mats of Ranunculus were common along with occasional tufts of Spirogyra, Zygnema, Vaucheria, Cladophora, and Nostoc. Short grass in the riparian zone carpeted the canyon floor. Juniper and occasional pinon pine occupied adjacent canyon slopes. A few springs on the canyon walls contributed minor flow to the creek. At the downstream site the canyon was over 75 m wide. Stream discharge was 0.756 m^3 sec^{-1} (26.7 cfs) and the stream was narrower and deeper with rubble and boulder substrate. The riparian area consisted of sandy soil with sparse patches of grass and tamarisk.

Flow in Bluewater Creek below the dam is regulated in accordance with the irrigation needs of the Bluewater-Toltec Irrigation District which owns and maintains Bluewater Dam. Records (USGS 1981) of past flood events show that up to 22.4 m^3 sec^{-1} (800 cfs) have been discharged into Bluewater Creek, but during some years stream flows average 0.03 m^3 sec^{-1} (1 cfs) due only to seepage at the dam.

The New Mexico Game and Fish Department has provided a sport fishery in Bluewater Creek downstream from the dam by stocking between 2,000 and 35,000 brown trout fry on numerous occasions since 1960. Trout were not stocked during the 1970s due, in part, to insufficient stream flow necessary to maintain the fishery; stocking was resumed in 1980 (Tom Moody, NMG&FD, personal communication). Other uses observed during this survey in addition to fishing were livestock watering and domestic water supply.

METHODS

Water temperature and conductivity were measured in the field using a Yellow Springs Instrument Company SCT meter. The hydrogen ion concentration was measured using a field pH color comparator kit (Hellige). The dissolved oxygen concentration was analyzed using the Winkler titration method and oxygen saturation was obtained using the nomogram method. Water samples for turbidity were analyzed in the laboratory in Santa Fe using a portable Hach turbidimeter. Fecal coliform bacteria, nutrients, and all other chemical constituents were analyzed by the Scientific Laboratory Division of the New Mexico Health and Environment Department (Table 1).

Benthic macroinvertebrate samples were collected quantitatively at each site using a circular sampler (Jacobi 1978). Macroinvertebrates were identified using appropriate taxonomic keys and data are presented and analyzed according to methods of Jacobi (1982) and Winget and Mangum (1979).

All chemical analyses were performed in accordance with the 14th edition of "Standard Methods for the Examination of Water and Wastewater (APHA 1975) and "Methods for Chemical Analysis of the Water and Wastes" (USEPA 1979). The validity of all environmental measurements are ensured by strict adherence to the procedures given in "Quality Assurance Project Plan for Water Pollution Control" (NMEID 1982).

RESULTS AND DISCUSSION

Data from both sites indicate Bluewater Creek is moderately cold, slightly alkaline, highly oxygenated, and contains low amounts of nutrients and other chemical constituents. There is a downstream increase in values for parameters such as temperature, turbidity, suspended solids, sulfate, and alkalinity (Table 1). Numeric criteria for parameters applicable to the stream standards were not exceeded.

Benthic macroinvertebrate standing crops (density as number/m^2) were dissimilar; the upstream site contained 40% fewer organisms than the downstream site. Total numbers of taxa and biological diversity indices were similarly low at both sites (Table 2). An evaluation of the physical habitat and key water quality parameters showed both sites to have the potential, based on the predicted community tolerance quotient or CTQ_p, of being high quality environments (Winget and Mangum 1979). However, an examination of the macroinvertebrate community using the biotic condition index method (BCI) of Winget and Mangum (1979) showed a community composed of tolerant organisms not typically indicative of high quality coldwater fishery streams (Table 2). Sensitive organisms such as stoneflies (Plecoptera) were absent and the fauna consisted of tolerant representatives of caddisflies (Trichoptera), true flies (Diptera), and worms (Oligochaeta).

Several authors (Briggs 1948, Powell 1958, Weber 1979, Spence and Hynes 1971, and Ward 1976a and b) have also observed the reduction or elimination of sensitive organisms such as stoneflies and a dominance of more tolerant fauna downstream from dams. Unseasonal releases of water

(extremes in fluctuations or constant flow conditions) not only affect the thermal regime (Ward 1976b), but also the flow regime (Lehmkuhl 1972) necessary for completion of macroinvertebrate life cycles.

In summary, water quality was good in Bluewater Creek downstream from the dam and the canyon environment is unique and aesthetically pleasing. The inferior quality of the benthic macroinvertebrate community and the repeated stocking of brown trout fry is attributed to the regulation of releases of water from Bluewater Dam for its primary uses of irrigation and domestic water supply. These designated uses would be impaired by the discharge of secondarily treated wastewater into the creek from Bluewater Lake State Park.

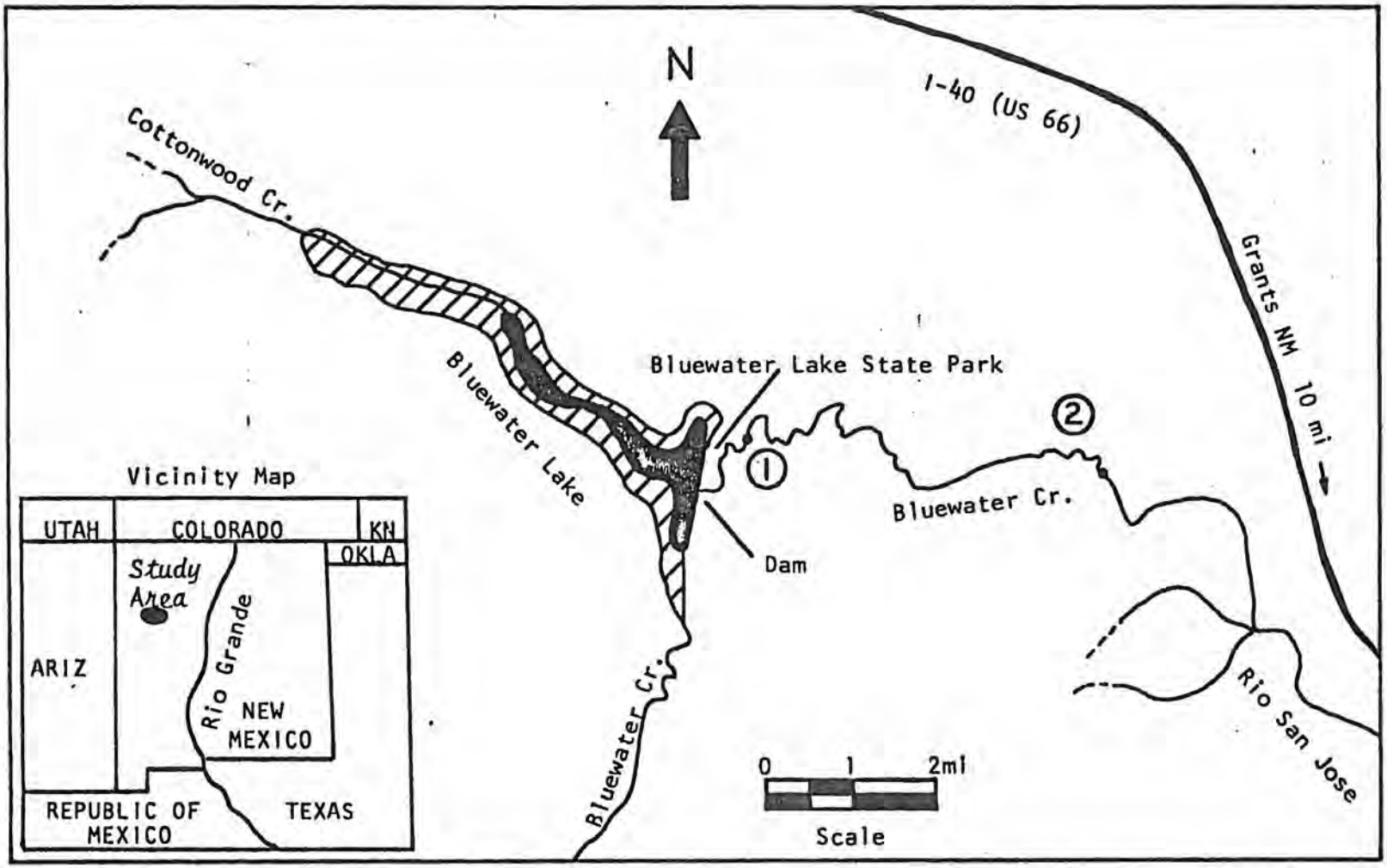

Figure 1. Bluewater Creek study site locations.

Table 1. Water quality at two sampling sites on Bluewater Creek downstream from Bluewater Dam, July, 1983.

Parameter (units)	Date	Sites	
		Bluewater Creek 1 mi downstream from dam	Bluewater Creek 7 mi downstream from dam
Temperature (°C)	7/20	18	21
	7/21	14.5	15
Conductivity (umhos at 25 C)	7/20	285	351
	7/21	290	360
pH (SU)	7/20	8.2	8.4
	7/21	8.0	8.0
Dissolved Oxygen (mg/l)	7/20	6.95	6.92
	7/21	7.70	7.70
O_2 saturation (%)	7/20	99%	103%
	7/21	100%	100%
Turbidity (FTU)	7/20	2	15
	7/21	5	13
Total Non-filterable Residue (mg/l)	7/20	7	37
	7/21	6	29
Fecal Coliform Bacteria (No. per 100 ml)	7/21	30	17
Total Phosphorus (mg/l as P)	7/20	0.05	0.07
	7/21	0.04	0.06
Total Kjeldahl Nitrogen (mg/l as N)	7/20	0.96	0.16
	7/21	0.19	0.27
Total Nitrite + Nitrate Nitrogen (mg/l as N)	7/20	0.02	0.01
	7/21	0.02	0.01
Total Ammonia Nitrogen (mg/l as N)	7/20	0.028	0.090
	7/21	0.097	0.032
Sulfate (mg/l as SO_4^{-2})	7/20	44.5	71.2
Alkalinity (mg/l as $CaCO_3$)	7/20	116	131
Discharge (Instantaneous) (m^3 sec^{-1})	7/20	0.671	0.756

Table 2. Benthic macroinvertebrates collected in Bluewater Creek, Valencia County, New Mexico, on July 20, 1983.

Taxa	Bluewater Creek (1 mi downstream from dam)	Bluewater Creek (7 mi downstream)
Trichoptera (caddisflies)		
Ochrotrichia sp.	313	57
Stactiobiella sp.	63	74
Hydropsyche sp.	68	1056
Helicopsyche sp.		6
Limnephilidae	11	
Lepidoptera (aquatic moths)		
Pararygyractus sp.	6	34
Coleoptera (beetles)		
Heterelmis sp.		74
Ephemeroptera (mayflies)		
Baetis sp.	855	1847
Tricorythodes sp.	17	
Traverella sp.		11
Diptera (true flies)		
U. K. larva		11
Simuliidae	735	382
Dicranota sp.	40	23
Glyptotendipes sp.	17	274
Eukiefferiella sp.	245	46
Cryptochironomus sp.	17	
Ceratopogonidae		51
Amphipoda (scuds/sideswimmers)		
Gammarus sp.	6	
Decapoda (crayfish)		
Orconectes (causeyi)	6	*
Oligochaeta (segmented worms)		
Tubificidae	29	131
Lumbriculidae		17
Nematoda (roundworms)	34	
Density (no./m^2)	2462	4094
Total Taxa	16	17
Diversity Index (H)	2.45	2.40
Index of Similarity	67%	
CTQ_p	53	53
CTQ_a	97.7	93.2
BCI	54	57

* present in non-quantitative sample.

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