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A WATER QUALITY ASSESSMENT OF COAL MINING EFFECTS
ON THE OBED WILD AND SCENIC RIVER

by

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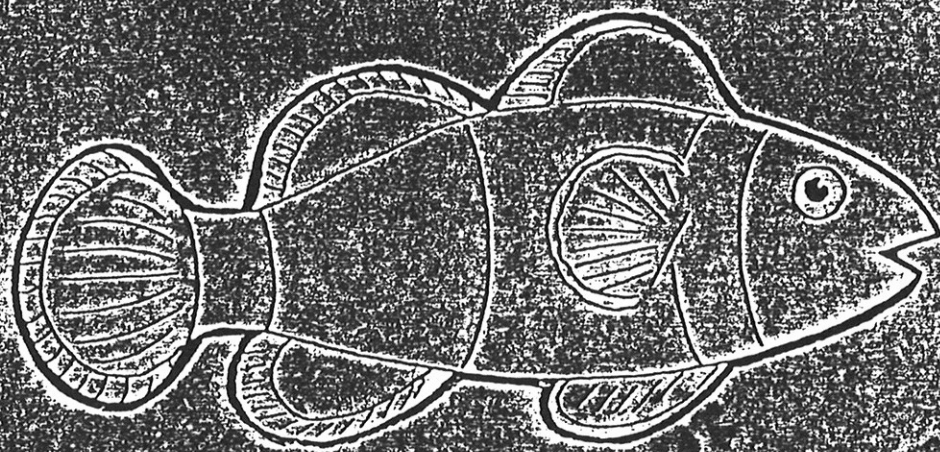
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ABSTRACT

Development plans for the Obed Wild and Scenic River (OWSR) have focused attention on the Obed and Emory River watersheds in the Cumberland Plateau of east Tennessee. The Scenic River is considered critical habitat of the spotfin chub (Hybopsis monacha). The purposes of this first order assessment of water quality were to determine the effects of coal mining on the chemical, physical and biological water quality in the Nemo Bridge area of the OWSR and to assist the National Park Service in its planning of water resource activities.

Poor water quality was found in the Emory River, Rock Creek, and Camp Branch during the 26 June 1979 field study. The causes of poor water quality were linked to discharges of acid mine leachates and silt into streams; both problems are the result of coal mining practices in the watershed. Water quality problems involving acid pH, high conductivity, siltation, and elevated toxic metal (Al, Fe, Mn, and Zn) levels were associated with these discharges. Judging from the available data, the impact of these discharges on water quality in the receiving systems is severe in subwatersheds in the coal mining areas and less severe in the primary river system. The potential for adversely affecting the use of the Obed Wild and Scenic River area by fish and wildlife is present and should receive immediate attention.

ADDENDUM

The spotfin chub, Hybopsis manacha, was collected on a follow-up fish survey, 15 August 1979 at three locations between Nemo Bridge Emory River Mile (ERM) 27.6 and the confluence with the Obed River (ERM 28.6). Robert Smith (F&WS) used a mask and snorkle to observe and direct the positioning of a seine to aid in the capture of H. manacha. Four adults and 8 juveniles were collected from the three sites. Two of the adults were "breeding colored" males. A total of 55 juveniles and 25 adults were observed. Hybopsis manacha is considered to be uncommon in the area of the Emory River assessed in this report.

INTRODUCTION

Basis of Study

The U. S. Fish and Wildlife Service, via a cooperative agreement with the Biology Department and the Environmental Biology Research Program at Tennessee Technological University, sponsored in June, 1979, a study to evaluate the chemical, physical, and biological water quality in part of the Obed Wild and Scenic River in Tennessee. The information generated in this study is to be used by the National Park Service (NPS) in its planning of water resource activities in that part of the watershed. This planning is in response to interest, from the U. S. Fish and Wildlife Service, for evaluating the effects of coal mining activities on critical habitat of the spotfin chub, Hybopsis monacha and other rare and endangered species in the Obed/Emory River system.

Background

Water quality within the Obed/Emory River basin is degraded by land use activities. Land use activities that are known to contribute to the degradation of water quality include urban development in Crossville, coal mining, and clearcutting activities.

Definitive water quality data documenting the extent and degree of impact do not exist. However, recognition that problems do exist is common as exemplified by both scientific investigators (Riddle, 1975; Parsons, 1958) and outdoor enthusiasts (Appendix A).

DESCRIPTION OF STUDY AREA

The Obed/Emory River basins lie within the Cumberland Plateau. The Cumberland Plateau is a relatively flat-topped, broad table which averages 1,000 feet above the adjacent lower land. The average surface elevation ranges from 1,700 to 2,000 feet above sea level. The streams investigated in this project are in Cumberland and Morgan counties. Important rock formations of the area are sandstone overlying shales, conglomerates and coals (DeBuchananue and Richardson, 1956). Coal is the most important mineral resource of this area in Tennessee.

Drainage Areas: Approximately 865 square miles are drained by the Emory River watershed in the Tennessee River Basin. The Emory River at Nemo Bridge, the downstream boundary for the Obed Wild and Scenic River (OWSR), has a drainage area of 612 square miles (Table 1). Major tributary drainages of the OWSR include the Obed River (520 mi²), Clear Creek (173 mi²), and Daddys Creek (175 mi²) (TVA, 1970).

Water Supply Characteristics

Rainfall over Cumberland and Morgan Counties averages 53 inches annually; March has the highest rainfall and October, on the average, is the driest month. Typically, the area experiences nearly 30 days of drought in the average year. The effect of prolonged drought on stream flow is exaggerated because of the underlying sandstone rock formation.

Sandstone rock is responsible for many stream characteristics in the Cumberland Plateau. First, the sandstone is moderately impervious to rainfall. Therefore, high floods from runoff are

Table 1. Drainage areas of the Obed/Emory Rivers system^a

<u>Name of Stream</u>	<u>River Mile</u>	<u>Location Reference</u>	<u>Drainage Area mile²</u>	<u>Max discharge (cfs)</u>	<u>Date</u>
Emory River	27.7	0.1 mile above Nemo Bridge (Nemo Bridge is downstream boundary for the Obed Wild and Scenic River)	612	185,000 ^c	23 Mar 1929
Emory River	28.4	Above mouth of Obed River	91.5	31,200 ^b	23 Mar 1929
Obed River	0	Mouth at Emory River Mile 28.4 near Nemo	520	72,800	3 Feb 1939
Obed River	4.4	Above mouth of Clear Creek	339		
Obed River	9.1	Above mouth of Daddys Creek	156		
Obed River	24.7	0.2 mile below Adams Bridge (upstream boundary for the Obed Wild and Scenic River)	92.4		
Clear Creek	0	Mouth at Obed River Mile 4.4	173		
Daddys Creek	0	Mouth at Obed River Mile 9.1 (includes 5.8 mile ² sink area)	175		

Source: Division of Water Control Planning, Hydraulic Data Branch, Tennessee Valley Authority, 1970.
 reading for 81 mi² drainage area.
 reading for 704 mi² drainage area.

common, and secondly, many streams cease to flow during droughts (TVA, 1968).

Quality of Water

Generally, the water is of sufficient quality for domestic use and certain light industrial users. The water hardness is low to moderate ($\sim 20-50$ mg/l) and acidity (pH) is nearly neutral. Some water on the plateau is affected by acid mine drainage; these waters typically have a very low pH (4.0-5.5) which tends to be corrosive. Moreover, the low buffering capacity of the plateau surface waters can tolerate only low levels of pollutants; this is of particular concern for protection of fish and their food organisms.

Definition of Water Quality

The physical, chemical, and biological characteristics of water collectively determine its quality. Thus, any assessment of water quality in a watershed must consider these aspects. Likewise, factors influencing these characteristics must be identified as they exist in the watershed. In a water quality assessment to be used for the planning of a water resources development program, not only the present status of water quality must be determined, but future changes in water quality must be estimated by considering how land use in the watershed may exist in the future.

Land Use

The land in the Emory River drainage is usually considered to be unsuitable for agricultural purposes in many areas (TVA, 1968). Part-time farming is used to supplement salaries from non-farm jobs.

The most important land use is for mineral production.

The most important minerals commodity of the area is bituminous (soft) coal which has been mined from as many as 63 mines in one year (1959). Reserves are estimated at 43,797,233 tons for Cumberland County, and 82,232,000 tons for Morgan County (TVA, 1968). Recent coal mining sites in the vicinity of the OWSR are shown in Figure 1.

Present land uses of concern to the Obed Wild and Scenic River, in decreasing order of magnitude, are estimated as follows: coal mining adjacent to the Obed Wild and Scenic River; clearcutting large areas along Clear Creek; and municipal sewage discharges from the Crossville area.

Sample Stations

Eight stations on 26 June, 1979 were established for this study in the OWSR (Table 2); three on the Emory River, one on the Obed River, two on Rock Creek, one on Camp Branch, and one on Daddys Creek. Criteria for selection of stations were based on the following: accessibility; effort at locating "red flag" areas; and characterization of areas known to be affected by coal mining runoff (Figure 1).

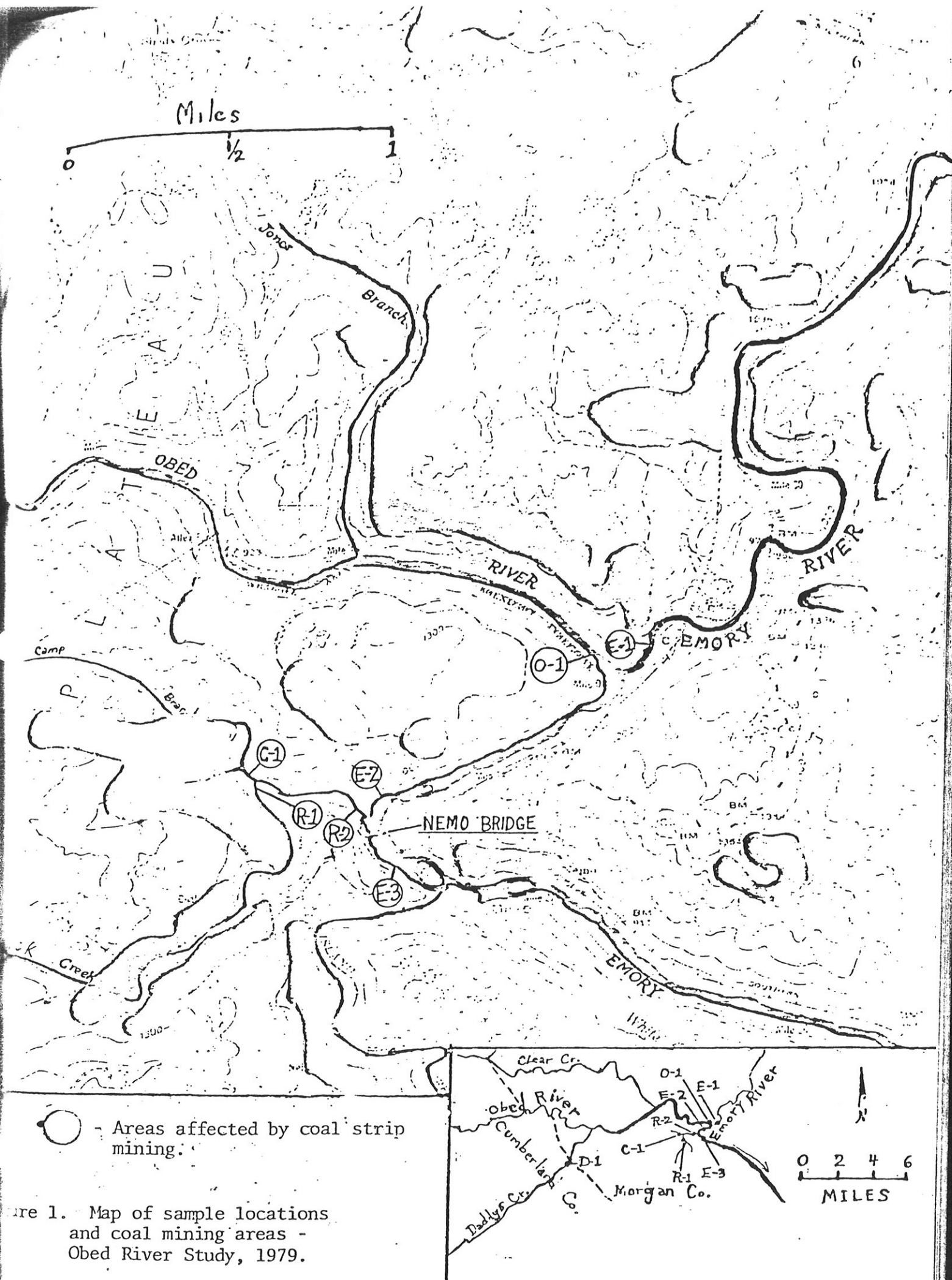


Figure 1. Map of sample locations and coal mining areas - Obed River Study, 1979.

Table 2. Stations on the Obed/Emory River Basins
in the Tennessee River Drainage.

STATION NUMBER	LOCATION
E-1 Emory River above Obed River mouth	Emory River Mile (RM) 28.6, Morgan County, Tennessee.
E-2 Emory River above Nemo Bridge	0.1 mile above bridge, RM 27.7, Morgan County, Tennessee.
E-3 Emory River below Nemo Bridge	0.1 mile below bridge, RM 27.5, Morgan County, Tennessee.
R-1 Rock Creek above Nemo Bridge	Upstream approximately .3 mile from the Emory River and 30 feet above mouth of Camp Branch, Morgan County, Tennessee.
R-2 Rock Creek at confluence with Emory River	50 yards upstream of creek mouth and 20 yards below Station E-2, Morgan County, Tennessee.
C-1 Camp Branch mouth	Approximately .3 mile upstream on Rock Creek and 20 feet above the mouth of Camp Branch; Morgan County, Tennessee.
O-1 Obed River mouth	50 yards above Obed RM 0, near the confluence with the Emory River, Morgan County, Tennessee.
D-1 Daddys Creek at Devils Breakfast Table	On Daddys Creek RM 2.3 in Cumberland County, Tennessee.

METHODS AND PROCEDURES

Chemical and Physical Measurements

Measurements were taken in riffle and pool areas for all stations in the Obed/Emory River Basins which were typical of that section of stream. Physical measurements that were taken included length, width, depth, and current velocity using a depth rod, tape measure, and a General Oceanics Model 2030 current meter. Chemical water quality was measured for 10 parameters by methods listed in Table 3. Conductivity was corrected to 25°C.

Benthic Macroinvertebrate Sampling and Analysis

Benthic macroinvertebrates were collected from riffle areas using a Surber sampler and an aquatic dip net. The Surber sampler (0.09 m²) had a net mesh size of 280 microns and the aquatic dip net had a mesh size of 500 microns. Three Surber samples were collected from similar habitats at each station for quantitative estimates of population density and species composition; the dip net was used to sample as many habitats as possible for a qualitative species inventory. Samples were preserved in the field in 10% formalin and returned to the laboratory where they were sorted and the organisms identified and counted. All organisms were identified to the lowest practical taxonomic level, usually to genus.

Community structure of benthic macroinvertebrates was determined for independent and cumulative samples at each station. This included the percentage of each taxa, the number of taxa, and species diversity ($\bar{d}$) (Wilhm and Dorris, 1966). For comparative

Table 3. Chemical analyses and methods used in survey.

<u>Parameter</u>	<u>Technique</u>
* Temperature	Electronic meter
* Dissolved oxygen	Standard Methods ^a
* pH	pH meter
* Conductivity	Conductivity meter
* Alkalinity	Standard methods
Aluminum (Al)	Atomic Absorption Spectrophotometer
Copper (Cu)	Atomic Absorption Spectrophotometer
Iron (Fe)	Atomic Absorption Spectrophotometer
Manganese (Mn)	Atomic Absorption Spectrophotometer
Zinc (Zn)	Atomic Absorption Spectrophotometer

* Denotes analysis made in the field.

^a Standard Methods, 14th edition, 1976.

purposes in this study, longitudinal responses of benthic macro-invertebrate communities to the severity of physical stress in the stream were analyzed with $\bar{d}$. $\bar{d}$ values less than 2 suggested a very stressed community and values greater than 3 indicated a healthy community; intermediate values reflected moderate stresses.

Justification for Using Benthic Macroinvertebrates as Water Quality Monitors

Benthic macroinvertebrates have been selected to serve as biological monitors in the Obed Wild and Scenic River area for four reasons:

- 1) quantitative sampling techniques are widely accepted and have been shown to be an effective method;
- 2) they are bottom dwellers of a rather sessile existence and most have long life cycles. If pollution exceeds a critical level, then groups of certain species, referred to as indicator species, will be extincted from the degraded stream area;
- 3) they are important sources of fish food; and
- 4) the richness of species will reflect the past history of a stream area. Water samples may not detect periodic toxic conditions in a stream that can harm fish and wildlife populations.

Fish Sampling and Analysis

Fish were collected using electrofishing and seining techniques. Four, 30 meter sections were sampled at each station. The location of each section was chosen to provide for sampling a diverse range of habitat types.

A total of two hours were spent sampling fish at each station. One hour per station was devoted to electrofishing using a backpack shocker (115 Volt AC) with a step-up transformer (600 Volt AC). Stunned fish were recovered with dip nets. In areas where flow was very swift, a block net was positioned across the stream to trap stunned fish as they were swept downstream. Seining techniques accounted for the second hour in the sampling effort. The "plant and kick" method, trap seining, and short downstream rushes were used. Fish were preserved in a 10% formalin solution and returned to the laboratory where they were sorted and the fish identified and counted.

Previous Fish Collections

Previous collections of fish from the Obed/Emory River drainages were taken by the Tennessee Valley Authority (TVA) (1970b) and Riddle (1975). Nine families and 56 species have been reported from the area (Appendix B). Notropis serralatus is the only new drainage record from this study.

FIELD ASSESSMENT OF WATER QUALITY

Water quality assessment from physical, chemical and biological measures will be presented separately for each sample station.

Station E-1 - Emory RM 28.6

Station E-1 is located above the confluence with the Obed River and in the vicinity of the Southern Railroad bridge. Coal mining at the Republic #1 mine is active approximately 0.8 mile upstream (Figure 1). The stream substrate was predominately boulders with few cobble sizes. Silt accumulations from upstream activities were very abundant between rocks in the streambed; these silt deposits were the most extensive observed during this survey. Water was colored slightly by suspended particles. Stream discharge was 20 cfs and the stream averaged 13 ft. width. Routine water chemistry indicated water quality typical of the drainage (pH 6.6, alkalinity 26 mg/l), except for the moderately high conductivity (89 μ mhos/cm) (Table 4). In addition, total iron concentration was moderately high (0.37 mg/l) at Station E-1. Historical data exists for a site six miles upstream and ten miles downstream at Oakdale; these data may indicate recent changes in water quality from mining. Median values for filtered iron was 0.04 mg/l and 49 μ mhos for conductivity (TVA, 1972).

Benthic macroinvertebrate communities reflected the effects of stresses which were not expected from the water data analyses. Macroinvertebrate density was estimated at 1,037/m² (Figure 2) and 23 taxa were collected in quantitative samples (Figure 3). Diptera had a relative abundance of 58% of all taxa present at this site,

Table 4. Water data analyses for the Obed/Emory River Basins survey on 26 June 1979.

PARAMETERS ^a	Daddys Cr. (Control) D-1	Emory R. E-1	Emory R. E-2	Emory R. E-3	Camp Br. C-1	Rock Cr. R-1	Rock Cr. R-2	Obed River @ Mouth O-1
Stream riffle width (ft)	11	11	33	40	2	2.3	2.6	-
Discharge (m ³ /sec)	0.94	0.56	3.5	3.6	0.008	0.008	0.016	-
(cfs)	33	20	123	124	0.3	0.3	0.58	-
pH (SU)	6.5	6.6	6.6	6.7	3.6	4.2	3.9	6.6
D.O.	7.3	7.1	7.2	7.4	8.8	8.8	9.1	7.1
Temperature (°C)	27	28	27	29	20	22	19	30
Conductivity*	73	89	67	60	462	129	230	48
Alkalinity	22	26	17	23	0	0	0	12
Al	0.14	0.05	0.05	0.02	3.71	1.60	2.50	0.03
Cu	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05
Fe	0.19	0.37	0.13	0.15	4.3	0.06	0.25	0.24
Mn	0.02	0.04	0.02	0.04	9.50	0.87	4.50	0.03
Zn	<0.1	<0.1	<0.1	<0.1	1.0	0.38	0.50	<0.1

^a All values expressed as mg/l unless otherwise indicated.

* (µmhos/cm @ 25°C)

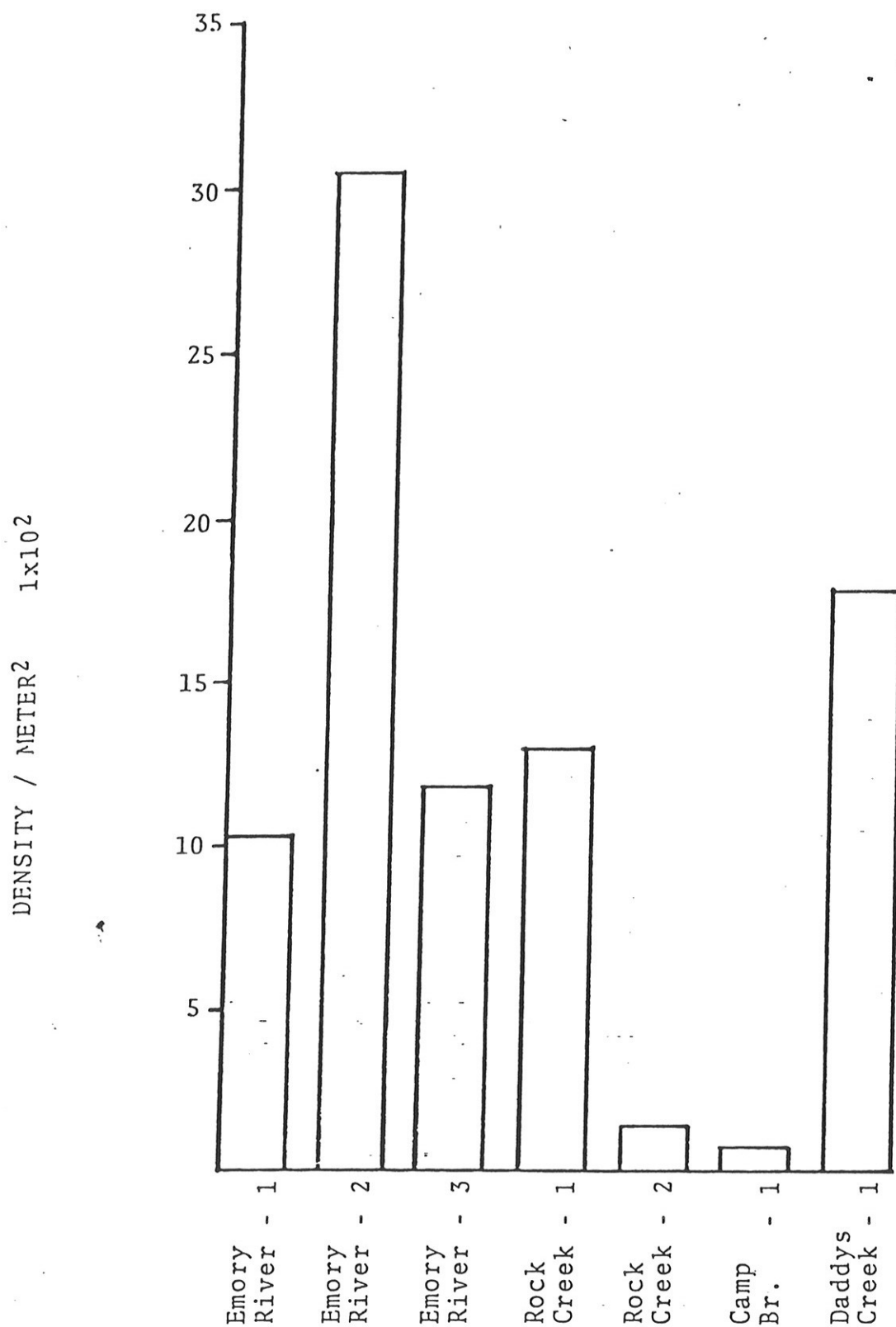


Figure 2. Density of benthic macroinvertebrates per square meter estimated from samples taken on 26 June 1979, in the Obed/Emory River Basins.

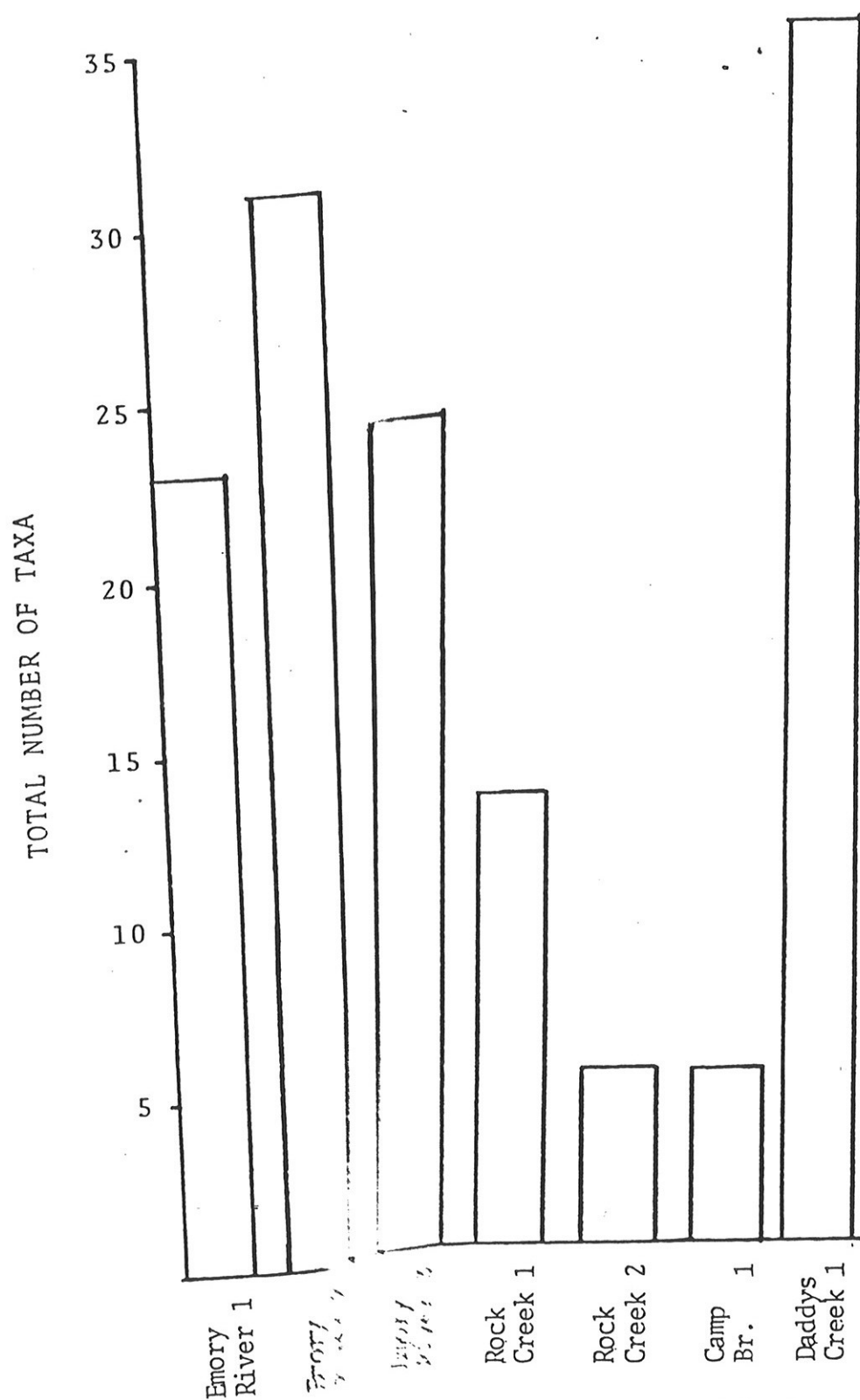


Figure 3. Total number of benthic macroinvertebrate taxa collected in 0.3 square meters on 26 June 1979, in the Obed/Emory River (cumulative of 3 Surber Samples).

while Coleoptera and Ephemeroptera densities were significantly reduced from expected numbers in a healthy stream (Figure 4, Table 5). Final evidence of a probable recurrent stress to benthic macro-invertebrate communities is shown in Figure 5. $\bar{D}$ values at Station E-1 were the lowest of any station on the Emory River, and suggested communities with poor to moderate health.

Fish collections recorded 14 species and only 31 individuals. These fish records represent a reduction from expected population levels for the Emory River. Five families of fish were represented in collections (Table 6).

Station E-2 - Emory RM 27.7

Station E-2 is located above the confluence with Rock Creek near Nemo Bridge. The station is located on the right side of the riffle and is influenced primarily by the Obed River discharge 0.7 mile upstream. Stream substrate was composed of boulders, cobbles, and areas of bedrock; periphyton growth made the rocks very slick to cross. Water willow (Justicia americana (L.) Vahl.) was abundant in the shallow areas and riffles. Stream discharge was calculated at 123 cfs. The stream width averaged 33 ft. Routine water chemistry showed this station had good water quality. Alkalinity (17 mg/l) and pH (6.6) measurements were typical of Plateau streams (Table 4). Water temperature in the gorge was 27°C in the riffle and as high as 29°C in shallow pools.

Benthic macroinvertebrate communities had the highest density (3,056/m²) of any station during this survey (Figure 2). Thirty-one taxa were present; Ephemeroptera (mayflies) were the dominant group (Figure 4, Table 5). Species diversity was higher at Station E-2

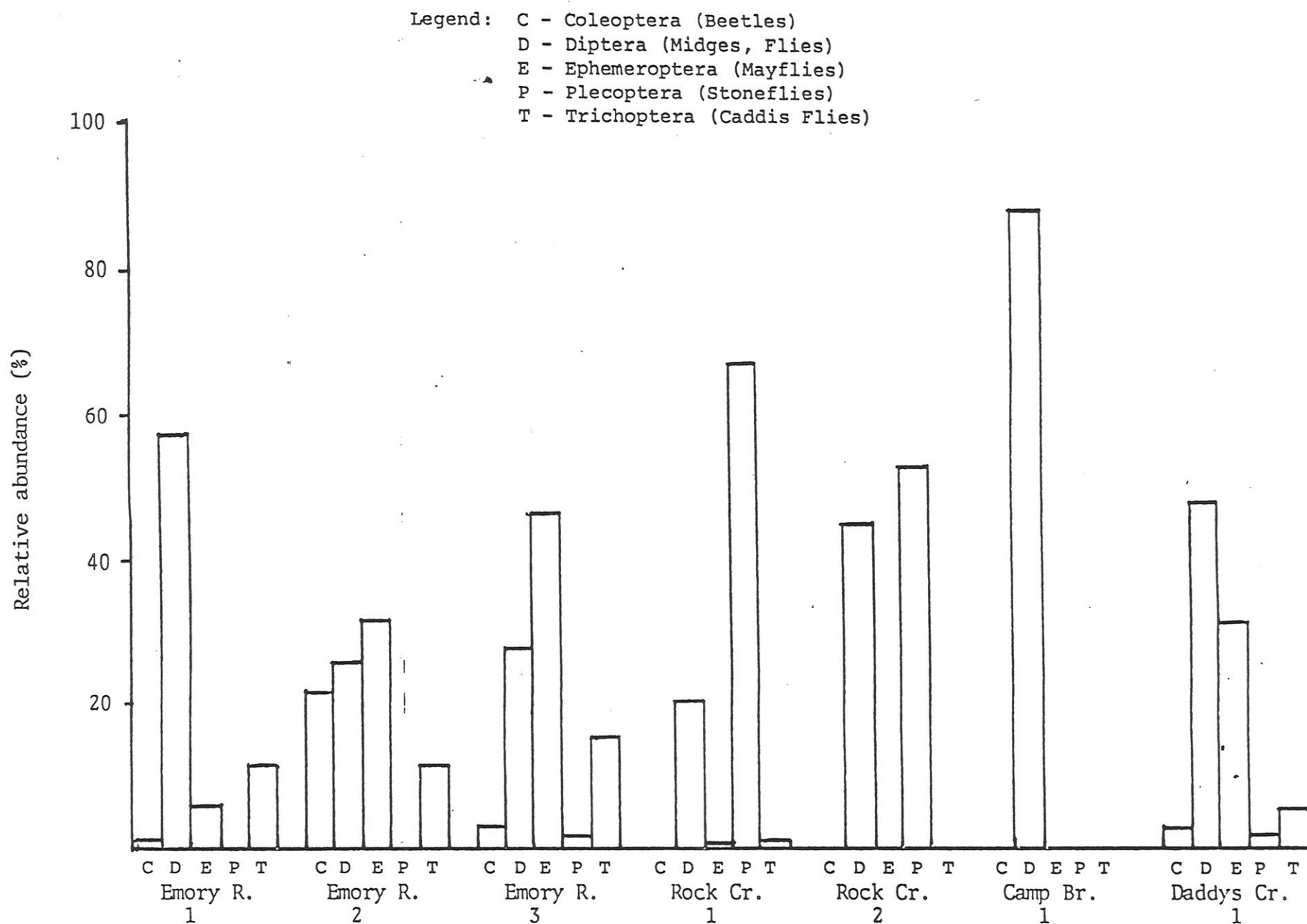


Figure 4. Percentage composition of major benthic macroinvertebrates taxa in the Obed/Emory River Basins (26 June 1979).

Table 5. Macroinvertebrate taxa list for the Obed/Emory River Basins.
(Mean number per square meter collected on 26 June, 1979.)

TAXA	STATION LOCATION						
	E1	E2	E3	R1	R2	C1	D1
PELECYPODA							
<u>Corbicula fluminea</u>		61	14				25
<u>Lampsilis</u>		+					
OLIGOCHAETA	201	43	25	111	4		14
ISOPODA							
<u>Lirceus</u>						4	
DECAPODA							
<u>Cambarus</u>							4
HYDRACARINA	29	68	32				151
EPHEMEROPTERA							
<u>Stenonema</u>	25	136	136				169
<u>Heptagenia</u>			4				4
<u>Baetis</u>	-	22	43				40
<u>Pseudocloeon</u>	25	445	79				47
<u>Caenis</u>	4	14	7				111
<u>Ephemerella</u>		11					4
<u>Isonychia</u>		54	7				4
<u>Tricorythodes</u>		18					14
HEMIPTERA	+					+	+
ODONATA							
<u>Argia</u>		4					11
<u>Hetaerina</u>	4						
<u>Gomphidae</u>							18
PLECOPTERA							
<u>Paraleuctra</u>	4			872	79		
<u>Acroneuria</u>		11	7	4			11
<u>Neoperla</u>			7				
<u>Perlesta</u>				4			4
MEGALOPTERA							
<u>Corydalus cornutus</u>		+					4
<u>Nigronia</u>	4	4		29		7	
COLEOPTERA							
<u>Stenelmis</u>	11	409	43				14
<u>Promoresia</u>		316					
<u>Dubiraphia</u>		4					
<u>Psephenus</u>		4					18
<u>Ectopria</u>	4						14

Table 5. (Continued)

TAXA	STATION LOCATION						
	E1	E2	E3	R1	R2	C1	D1
DIPTERA							
Chironomidae	477	628	319	255	50	68	750
Simuliidae	22	65	4				4
Empididae	4	11					4
Palpomyia				11		7	4
Tipula					4		
Antocha	75	32					18
Atherix		7	7				
TRICHOPTERA							
Hydroptila	83	25	7				25
Oxyethira			4				4
Micrasema		158	7				4
Ceraclea	4						
Chimarra	4						
Hydropsyche	4	118	86	4			7
Neureclipsis	7	43	65	4			
Psychomyia							7
Pychopsyche							4

+ Species in qualitative sample only.

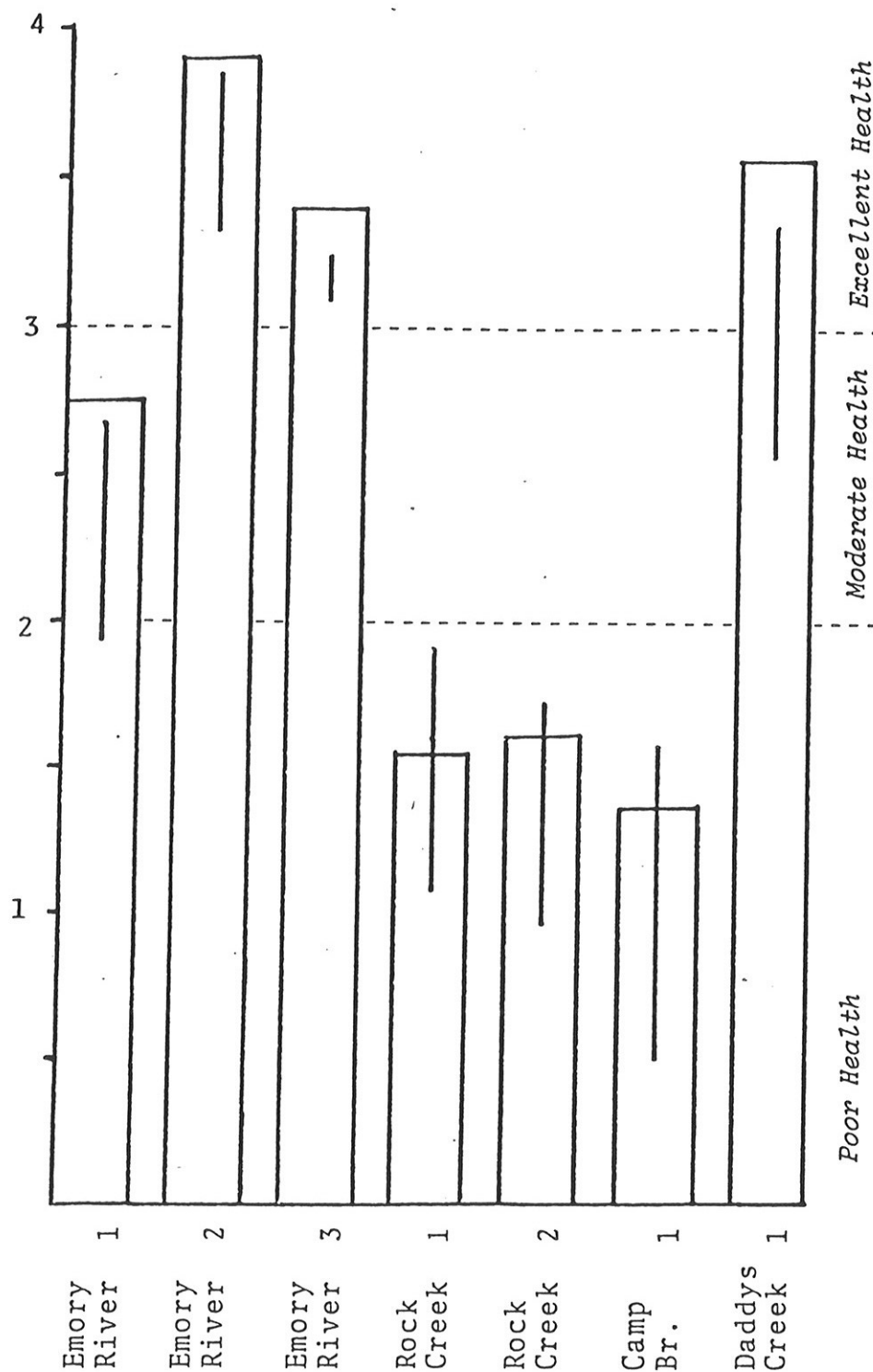
SPECIES DIVERSITY $\bar{D}$ 

Figure 5. Cumulative species diversity ($\bar{D}$) for benthic macroinvertebrate communities at each sample station. Vertical line through histogram shows range of values for the 3 quantitative samples collected on 26 June 1979 in the Obed/Emory River Basins.

Table 6. Fish species collected on 27 June, 1979 in the Obed/Emory River Basins. (Total number of fish caught in four 30 m sections.)

SPECIES	Emory River E-1 (Above Obed Mouth)	Emory River E-2 (.1 mi above Nemo Bridge)	Emory River E-3 (.1 mi below Nemo Bridge)	Rock Creek R-1 (Above Camp Br. Mouth)	Rock Creek R-2 (Above Nemo Bridge)	Camp Br. C-1 (Tributary of Rock Cr.)
Herring Family - Clupeidae						
Gizzard shad	1					
Minnow Family - Cyprinidae						
Carp	^a					
Stoneroller	4	5	3			
Warpaint shiner	3	2	4			
Whitetail shiner	8	16	16			
Rosefin shiner	1	11	5			
Tennessee shiner	2		6			
Silver shiner			1			
Spotfin shiner		7				
Telescope shiner		6				
Mimic shiner		30				
Steelcolor shiner		5				
Notropis serralatus		1				
Sucker Family - Catostomidae						
Northern hogsucker		1				
Catfish family - Ictaluridae						
Yellow bullhead	1					
Flathead catfish	1					
Sunfish Family - Centrarchidae						
Rockbass	1	1				
Longear sunfish		1				
Smallmouth bass	1	2				
Perch Family - Percidae			1			
Greenside darter	4	9				
Redline darter	3	8				
Bluebreast darter		2				
Tn. Snubnose darter		1				
Yellow darter	1	13				
Logperch		2				
Total number of Species	14	19	7	0	0	0
Total number of Individuals	31	123	36	0	0	0

^a Observed in pool.

than at any other station (Figure 5). The quantitative benthic samples confirmed the existence of good water quality.

Fish collection records in Table 6 list the 19 species recorded at E-2. The mimic and whitetail shiners were the most abundant fish in the collections. Representatives of four families were present (Table 6).

Station E-3 - Emory RM 27.5

Station E-3 is located approximately 0.1 mile below the mouth of Rock Creek, a tributary degraded by acid mine runoff. This station was selected to assess the effects of the Rock Creek discharge on the Emory River. Station E-2 served as a control for this station. Stream substrate was similar to the composition at Station E-2, predominately boulders. Stream discharge was

124 cfs. The riffle was 40 ft wide and located below a long pool extending from the confluence with Rock Creek. Water chemistry was similar to values obtained at the upstream control station (Table 4). The grinding force of floods on the substrate was evident from grooves on the otherwise polished rock surfaces.

Benthic macroinvertebrate communities had an estimated density of 1,187/m² and 24 taxa present (Figure 2 and 3). Ephemeroptera (mayflies), Diptera (flies), and Trichoptera (Caddis flies) were abundant (Figure 4, Table 5). Species diversity was very high at Station E-3, indicating good water quality (Figure 5).

Fish collections yielded seven species of fish and 36 individuals (Table 6). This station was difficult to sample because of the clear water and swift current in downstream sections. Only two families were represented in the collections.

Station R-1 - Rock Creek RM 0.3

Station R-1 is located upstream from the mouth of Camp Branch; this creek discharges its water into the Emory River 50 yards below Station E-2. This station is known to be receiving acid mine runoff from inactive sites near the Catoosa Wildlife Management Area (Figure 1). Stream substrate was cobble and pebble size. The stream is overshadowed by dense rhododendron growth. Stream discharge was 0.3 cfs on 26 June, 1979. Poor quality water was apparent from pH (4.2), alkalinity (0 mg/l) and high conductivity (129 μ mhos). The acid mine leachates had high concentrations of aluminum (1.6 mg/l), zinc (0.38 mg/l), and manganese (0.87 mg/l) (Table 4).

Benthic macroinvertebrate community density was 1,306/m² with a stonefly (Paraleuctra) representing 67% of the individuals. A total of 13 taxa were collected at this station (Figure 3); most were Plecoptera (stoneflies) and Diptera (flies) (Figure 5). No fish life was supported in Rock Creek.

Station R-2 - Rock Creek (50 yards above mouth)

The degraded water quality shown at Station R-1 also occurs at Station R-2. Acid mine runoff is received from the headwater of Rock Creek, and moreover, from active mines drained by Camp Branch. The substrate is composed of cobble size rocks covered with "yellowboy," a ferric hydroxide ($\text{Fe}(\text{OH})_3$) precipitant. Water quality was poor (Table 4). Biological communities were almost non-existent (Table 5, Figures 2 and 3). Macroinvertebrate species diversity values (Figure 5) reflected the toxic conditions in Rock Creek. No fish were found to exist in this stream.

Station C-1 - Camp Branch (Confluence with Rock Creek)

Camp Branch had the most degraded water quality of any station during this survey. Ferric hydroxide coated all the substrate and wading in the stream was very unpleasant due to the burning sensations. The pH (3.6) and conductivity (462 μ mhos) are typical of severely degraded water quality from acid mine drainage (Table 4). Metal concentrations were extremely high for aluminum (3.71 mg/l), iron (4.3 mg/l), manganese (9.5 mg/l) and zinc (1.0 mg/l) (Table 4). Five taxa of macroinvertebrates were collected through the sampling effort (Table 5). Species diversity values indicated poor stream health (Figure 5). No fish are capable of surviving in Camp Branch at the present time.

Station D-1 - Daddys Creek (At Devils Breakfast Table)

Station D-1 is located 2.3 miles above the mouth of Daddys Creek. The stream substrate was predominately cobble size. Stream width was 11 ft and the discharge was 33 cfs on 26 June, 1979. Water chemistry showed good water quality for pH (6.5), and alkalinity (22 mg/l), in addition to low levels of metals (Table 4).

Benthic macroinvertebrate communities indicated a healthy stream. Daddys Creek had a moderately-high density (Figure 2) for Plateau streams; this stream had the largest number of taxa in samples taken during this survey (Figure 3). Diptera and Ephemeroptera were the two most abundant taxa in Daddys Creek. $\bar{D}$ values for this stream indicated good stream health (Figure 5). Fish collections were not taken at the time of the survey.

Station O-1 - Obed River (At confluence with Emory River)

Station O-1 was located 50 yards above the mouth of the Obed River. This station only was operated for chemical water quality analyses. The sample was collected from the 700 yards long pool at the Obed River mouth. This station is a very popular fishing hole for the Muskellunge (Esox masquinongy ohioensis). Water quality analyses are given in Table 4. Conductivity (48 μ mhos) at this station was the lowest reading for the survey. Other chemical analyses indicate good quality water. Biological samples were not collected.

ANALYSIS OF WATER QUALITY IN THE WATERSHED

Presently (June, 1979) water quality in the vicinity of the Obed Wild and Scenic River is of two types: 1) good water quality exists in the lower Obed River section and in the Emory River section below the Obed River mouth; and 2) poor water quality is suspected in the Emory River section above the Obed River confluence, Rock Creek, Camp Branch, and other tributaries to the lower section of the Obed River. The cause of poor water quality is discharges of acid mine leachates and silt into streams; both problems are the result of coal mining techniques in the watershed. Water quality problems such as acid pH, high conductivity, siltation and elevated toxic metal levels can be associated with these discharges. Judging from the available data, the impact of these discharges on water quality in the receiving systems is severe in subwatersheds in the coal mining areas and less severe in the primary river system, excluding the Emory River above the confluence with the Obed River. However, pre-coal mining era baseline water quality data is not available for any of these streams.

Several subbasins in the Emory River Watershed have possible water quality problems attributable to acid mine drainage. Emory River site E-1 received non-point source siltation and acid mine leachates from the Republic #1 mines (Walt Mayer, NPS, personal communications). Chemical water quality probably would be affected adversely following rainstorms. Emory River site E-1 was found to have moderately high conductivity, evidence of a high sediment load, and a depressed macroinvertebrate community. These factors suggest that mining activities in the watershed are adversely

impacting water quality. Biological and chemical water quality from Rock Creek, and Camp Branch demonstrate "red flag" areas having poor water quality. The Obed River and Daddys Creek may have enrichment problems from contamination by industrial and domestic sewage released near Crossville, although the chemical water quality was good at the sample points used for the study. The Obed River, at present, is believed to dilute the toxic discharges from problem areas. The potential for adversely affecting the use of the Obed Wild and Scenic River (OWSR) area by fish and wildlife is present and should receive immediate attention.

The review of problems in the Emory Watershed for this project indicated tributary streams to the OWSR are degraded from three sources. 1) Coal mining primarily in Morgan and Fentress Counties affect many streams near the Obed and Emory Rivers confluence (Republic Coal Company) and along parts of Clear Creek. 2) Clearcutting timber between Jett Bridge and Lilly Bridge adjacent to Clear Creek (Hiawassee Land Company) is causing siltation problems in Clear Creek. 3) Sewage released by Crossville, local industries, and resorts pollute the upper section of the Obed River and are suspected of reducing fish populations (especially Muskellunge).

Recommendations

The results of this first order assessment of water quality demonstrated serious and severe water quality problems in several sections of the Obed/Emory River Basins. For the purposes of

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watershed planning, those problems should be evaluated in greater detail and carefully considered in NPS project planning and decision making. Since the spotfin chub has critical habitat area within the OWSR, attention should be focused on the following points:

- 1) The role of small tributary streams of the Obed/Emory Rivers in providing breeding areas for fish and wildlife.
- 2) The effects of acid mine drainage on the mainstream water quality after rainstorms.
- 3) Locate and characterize water quality of all tributaries draining coal mining areas to assess the impact on the OWSR environs.
- 4) The impact of high sediment loads on the fish and other stream life should be evaluated.

RIVER CONSERVATIONObed National Wild and Scenic River

Our last newsletter reported mining activities by Republic Coal Company (Delta Development) within 2000 feet of Nemo Bridge on the Catoosa side. (There is a second, unpermitted site nearby operated by Skiles Coal.) Republic has also been issued a permit to work an abandoned site within view of the Emory River approximately 1 mile upstream from Nemo Bridge on the Wartburg side. Both Republic operations are supposed to be deep mines, and all three mines are just outside the designated National Wild and Scenic River area. In conjunction with mining, Republic apparently plans to construct a coal washing facility and coal tipple near the abandoned railroad tunnel, and possibly a system to convey coal across the river. Technically, the Republic operations are legal, though they clearly pose a threat to the water quality, wildlife, and wilderness of the area.

Federal Mining Legislation

The Surface Mining Control and Reclamation Act of 1977 requires that states determine lands that are unsuited for surface mining. A surface area may be designated unsuitable for certain types of surface coal mining operations if such operations will

1. be incompatible with existing state or local land use plans; or
2. affect fragile or historic lands in which such operations could result in significant damage to important historic, cultural, scientific and esthetic values and natural systems; or
3. affect renewable resource lands; or
4. affect natural hazard lands (earthquakes, flooding); or
5. affect lands which cannot be reclaimed.

State Mining Legislation

The state is currently in a transition period during which it must modify its present law to comply with the 1977 federal statute. Primary responsibility for drafting the state legislation rests with the Department of Conservation. The current version of the bill is backed by FACTS, a coal lobbyist group, and has received verbal support from many representatives. We need to study this bill to determine if it will meet our needs.

TSRA recently sent Bill Mitchum to meet with Ann Tuck, new Commissioner of Conservation. He expressed our support for better enforcement of surface mining laws, funding for the state scenic rivers program, and inclusion of the entire Obed/Emory watershed in the National Wild and Scenic River system. Bill reports that this was a productive talk, which was also attended by representatives of the Tennessee Environmental Council and Tennessee Trails. Apparently funding is going to be a problem, particularly this year (vestiges of the Blanton budget), and several state programs are endangered. However, Mrs. Tuck seemed receptive to conservation needs and willing to fight for better funding in upcoming budgets.

Dear Editor:

It snowed today and the Tellico will probably be up this weekend. Ah! my favorite. But I just can't bring myself to face the Iceman this year. I know, winter paddling can be very beautiful, but a couple years ago while perched on a rock in the narrows of the Little T (freezing, wet suit caked with ice, both thumbs long since past feeling, snow blowing in my face, could not find my feet) I decided right then and there---This is Crazy...Don't Do This Again!!

However, I ain't been idle. The "Got to Have a New Vehicle" fever got me this winter. That's Ve-Hickle in Chattanooga. Reflecting back on some of the stuff we've all been through, I came up with a partial list of criteria this Ve-Hickle must meet.

1. Must be new--Squeaky new-new: cures the fever but gives headaches at payment time.
2. Travels muddy roads--All take outs.
3. Travels steep muddy roads--Section IV take out.
4. Travels steep muddy trail with boulders & logs--Cheat Canyon take out.
5. All of #4 plus---while dragging 6 boats behind with 4 boats on top at 10:00 p.m.--Town Creek take out. Ah! A solid class IV take out.
6. All of #5 plus---with 6 or 7 river rats inside (preferably muddy), during a blizzard--1st Gauley take out. A solid class V!
7. Zips down the freeway at 70 mph (to keep within radio range of Bob McClelland).
8. Zips down the freeway at 70 mph (for several hours while following Bob McClelland & not being able to stop for a rest room).
9. Radio for help if lost.
10. Radio for help if found.
11. Be earth tone colors so vandals can't find it.
12. Protect itself against vandals.
13. Self-destruct if the b*!#@\$\$ get inside ---while they're inside.
14. Store necessities-- Icebox, beer, sink, food, heater, dry clothes, cigs, stove, stereo, etc.
15. Store optionals-- Boat, paddle, PFD, rope, etc.
16. Lower boats, gear & Stansberry down 40' sheer cliffs.
17. Pull boats & gear up 40' sheer cliffs.
18. Pull itself out of any hole I might drive into.
19. Pull Pickett out of any hole he might drive into.
20. Be machine washable (preferably self-cleaning).
21. Load Boats -- By itself
 - Run shuttles " "
 - Drive home " "
22. Withstand routine boat loading procedures ---
 - Walking on roof
 - Walking on roof by 3 or 4
 - Dropped boats on windshield
 - Flying rubber tie-downs
 - Ropes tied everywhere --- door handles, tail pipe, antenna, steering wheel, etc.

Such a Ve-Hickle is now in my possession and will be unveiled, or unraveled, which ever comes first, at White Water Camp. Entry restricted to those with muddy, wet, grungy shoes, and wet suits.

The River Machine Cometh! (If any of you turkeys figure out what it is call me. Ah, hell, call me anyway...)

Bye Bye Timanus

Clifton O. Timanus has resigned, effective March 1, from the Water Quality Board as well as the Health Facilities Commission. As you may recall (see March newsletter), Dr. Timanus tried to bribe two state officials to speed up strip mining permits. One of the coal companies involved was, you guessed it, Republic Coal, denizen of the "deep" mines on the Emory river. Timanus resigned in exchange for immunity from criminal prosecution. We are hopeful that Governor Alexander will appoint someone who truly represents the state's conservation interests to the Water Quality Board.

Bottle Bill -- Know Your Opposition (from the Environmental Action Fund)

The following reasons are most often given in opposition to the Bottle Bill. ("Carbonated Beverage Container Refund Bill")

1. It is discriminatory. Why pick on bottlers, what about all of McDonald's trash, etc?

Paper will eventually decay, bottles and cans are forever. We already have anti-litter laws but they are difficult to enforce (and are not enforced). The Bottle Bill is an effort to stop the litter before it gets started.

2. Why not wine and whiskey bottles?

Because they are a relatively small factor in the problem and we want a bill we have a chance of seeing passed.

3. It will cost too much.

The General Accounting Office report shows a decrease in cost when 5 factors are considered -- cost of capital, cost of labor, container cost, retainer deposits, transportation.

4. The Oregon bill has not succeeded.

We have a letter from the office of the Oregon governor stating total satisfaction with the result of their bill. (for a copy, contact Environmental Action Fund)

5. Resource savings are too small to matter.

It is not too small when you consider the magnitude of the problem and the increasing severity. 90% of bauxite for aluminum is imported -- it would be cheaper and more sensible to recycle this valuable material.

6. Prison workcamps can be used to clean up the litter.

This concept may be a good one but it would seem more likely that prisoners would be put to work doing more urgent things such as repairing roads.

Contact your elected representatives (Senate, House, Governor),
Contact your local media,
Write a letter to the editor of your newspaper.

Wilderness Area Review and Evaluation Program (RARE-II)

The RARE-II recommendations were a disaster for Tennessee:

Tennessee citizens for wilderness planning --

RARE-II recommendations for the Cherokee National Forest were released to Congress on May 4, 1979. The results were terribly disappointing and destroyed any hope that the Forest Service was moderating its previous anti-wilderness position. Presently, 1.3% of Cherokee are designated wilderness; the RARE-II recommendations would add only a paltry .5%, for a total of 1.9%. Tennessee has the dubious honor of receiving the lowest wilderness recommendation of any state in the Southeast (N.C. did 20 times as well).

Nick Sullivan in The Tennessean --

TENNESSEE led the Southeast in the public response to the recent wilderness inventory by the U.S. Forest Service, and most of the response was negative.

M. K. Lauritsen, supervisor of Cherokee National Forest in East Tennessee, said massive rejection by the public was the prime reason only one of 22 possible wilderness areas in the national forest was proposed by the Forest Service for wilderness designation under the RARE II (Roadless Area Review and Evaluation) program.

"THE CHEROKEE National Forest Service received 21,000 pieces of mail during the public response period following the completion of the inventory in the fall of 1977," Lauritsen said. "We never have had a response like this. We had more response than any state in the Southeast and we were fifth in the nation.

"The Forest Service had vowed to give strong weight to the wishes of the public in designating or not designating wilderness areas," he said. "If the vote count had dictat-

ed entirely our recommendations there would have been no areas recommended for wilderness in Cherokee. Over 91 percent of the mail we received was against more wilderness in Tennessee."

The final Environmental Impact Statement was filed in January and only the 4,000-acre Bald River Gorge area was recommended for wilderness. Six other areas were retained for additional study for possible inclusion in the wilderness system at a later date. The remaining tracts will be downgraded to non-wilderness status and will become available for possible development.

Even in Business Week (Jan. 29)

The U.S. Forest Service should think in terms of generations if not of centuries. But continuing pressure from lumbermen, mining companies, and enterprising recreational developers makes it hard for Forest Service officials to think beyond the day's schedule of appointments. The result is a built-in bias in favor of early utilization which shows in the recommendations the Forest Service has just drawn up for classifying some 62 million acres of undeveloped land in the national forests.

Any decision allocating land to various uses -- timber, grazing, oil and gas exploration, or recreation -- is going to leave someone dissatisfied, but in this case the critics are right when they say that the Forest Service could have done better. It did not have to choose between keeping land forever wild or opening it for immediate development. There is a third option: Designate the land for "further study." This would have preserved it in wilderness state without closing it entirely to exploration for oil and minerals.

Once land is opened for development, the decision is irrevocable. Both industry and the environmentalists acknowledge that in many cases they do not know enough about a tract to make such a final determination. "Nobody has been through some of this land since Lewis and Clark," admits one timber company official.

Under the circumstances, it would have made sense to put a large part of the 62 million acres in the "further study" classification. Since the Forest Service did not make this move, Congress should overhaul the recommended program to keep future options open.

Appendix B. Fish species list from recent records
for the Obed/Emory River Basins.

Scientific Name	Common Name	Collectors a
Clupeidae		
<u>Dorosoma cepedianum</u>	Gizzard shad	2,3
<u>Miodon tergisus</u>	Mooneye	2
Esocidae		
<u>Isox masquinongy ohioensis</u>	Muskellunge	1,2
Atherinidae		
<u>Labidesthes sicculus</u>	Brook silverside	1
Cyprinidae		
<u>Campostoma anomalum</u>	Stoneroller	1,2,3
<u>Cyprinus carpio</u>	Carp	2,3
<u>Hybopsis monacha</u>	Spotfin chub	2,4
<u>Nocomis micropogon</u>	River chub	1,2
<u>Notropis ardens</u>	Rosefin shiner	2,3
<u>N. ariommus</u>	Popeye shiner	1
<u>N. coccogenis</u>	Warpaint shiner	1,2,3
<u>N. cornutus</u>	Common shiner	1,2
<u>N. galacturus</u>	Whitetail shiner	1,2,3
<u>N. leuciodus</u>	Tennessee shiner	1,2,3
<u>N. photogenis</u>	Silver shiner	1,3
<u>N. serralatus</u>	(manuscript, undescribed)	3
<u>N. spilopterus</u>	Spotfin shiner	2,3
<u>N. stramineus</u>	Sand shiner	2
<u>N. telescopis</u>	Telescope shiner	2,3
<u>N. volucellus</u>	Mimic shiner	1,3
<u>N. whipplei</u>	Steelcolor shiner	1,3
<u>Phenacobius mirabilis</u>	Suckermouth minnow	1
<u>Rhinichthys atratulus</u>	Blacknose dace	2
<u>Semotilus atromaculatus</u>	Creek chub	1,2
Catostomidae		
<u>Catostoma commersoni</u>	White sucker	1,2
<u>Hypentilium nigricans</u>	Northern hogsucker	1,2,3
<u>Moxostoma duquesnei</u>	Black redhorse	1,2
<u>M. erythrurum</u>	Golden redhorse	1,2
Ictaluridae		
<u>Ictalurus melas</u>	Black bullhead	1
<u>I. natalis</u>	Yellow bullhead	1,2,3
<u>I. punctatus</u>	Channel catfish	1,2
<u>Pylodictis olivaris</u>	Flathead catfish	1,2,3

Appendix B. (Continued)

Scientific Name	Common Name	Collectors ^a
Centrarchidae		
<u>Ambloplites rupestris</u>	Rockbass	1,2,3
<u>Lepomis auritus</u>	Redbreast sunfish	1,2
<u>L. cyanellus</u>	Green sunfish	1,2
<u>L. gulosus</u>	Warmouth	1
<u>L. macrochirus</u>	Bluegill sunfish	1,2
<u>L. megalotis</u>	Longear sunfish	1,2,3
<u>Micropterus dolomieu</u>	Smallmouth bass	1,2,3
<u>M. punctulatus</u>	Spotted bass	1,2
<u>M. salmoides</u>	Largemouth bass	1,2
Percidae		
<u>Etheostoma blennioides</u>	Greenside darter	1,2,3
<u>E. camurum</u>	Bluebreast darter	2,3
<u>E. cinereum</u>	Ashy darter	2
<u>E. jessiae</u>	Blueside darter	1
<u>E. kennicotti</u>	Stripetail darter	1,2
<u>E. maculatum</u>	Spotted darter	1,2
<u>E. rufilineatum</u>	Redline darter	1,2,3
<u>E. simoterum</u>	Tenn. snubnose darter	1,2,3
<u>E. zonale</u>	Banded darter	1
<u>Percina aurantiaca</u>	Yellow darter	1,2,3
<u>P. caprodes</u>	Log perch	1,2,3
<u>P. evides</u>	Gilt darter	1
<u>P. macrocephala</u>	Longhead darter	2
<u>P. squamata</u>	Olive darter	1,2
Sciaenidae		
<u>Aplodinotus grunniens</u>	Drum	2

- ^a 1 - TVA, 1970b
 2 - Riddle, 1975
 3 - Present study
 4 - 15 August 1979

HARRIS SAYS STRIP MINING IS BARRED ON FEDERAL LANDS IN NATIONAL PARKS

There will be no coal mining on federal lands in the National Park System, Office of Surface Mining Director James Harris told the House Interior Committee last week. Harris was responding to a recent warning by the National Park Service that a proposed OSM redefinition of the term "valid existing rights" could open 1.7-million acres within national parks to surface mining (*Inside Energy/with Federal Lands*, 6 Sept., 12).

Harris, whose testimony opened the first of two days of committee oversight hearings on the federal surface mining program, said the controversial definition is only one of three options for redefining valid rights proposed by the agency. "We posed these options to stimulate the broadest possible public debate and comment for our use in developing the final regulation," Harris said. "I think it is safe to say that we succeeded in that regard."

Harris pledged that there would be no mining on federal lands in the parks. But a National Wildlife Federation representative said later that Harris' pledge is misleading. It is private inholdings in national parks that would be opened to surface mining under the proposed definition, he said.

Rep. John Seiberling, D-Ohio, was not present at the hearing last Thursday. Seiberling was expected to take Harris to task for the valid-rights proposal. He was, however, expected to be present to question Harris on the issue on day two of the hearings last Friday.

Rep. Morris Udall, D-Ariz., Interior Committee chairman, said he was disappointed that, on the fifth anniversary of the federal surface mining law, regulations were still unresolved. Udall, who was the primary author of the 1977 act, did not say whether he would support legislative amendments to the law in the upcoming year.

American Mining Congress representative Stephen Young said that his group believes that amendments are needed in five areas. The law is too restrictive on mountain-top mining; terracing and other variances from approximate original contour; permitting procedures; environmental reviews under the National Environmental Policy Act; and revegetation protection, Young said.

AMC's Christopher Farrand applauded OSM for eliminating "cookbook" standards in its rules. He said, however, that the group has several "critical" concerns with the rule revisions so far. For instance, requiring sedimentation ponds at all sites when other effective methods are available is burdensome, particularly in the West, said Farrand. Regulations governing mining on alluvial valley floors require needless and costly studies of minor streams and drainage areas, he added.

NWF said OSM is "cutting the heart out of" the federal strip-mine rules. Jay Hair, NWF vice president, cited, in addition to the redefinition of valid rights, an OSM prohibition against unsuitability petitioning on federal lands and the agency's shift away from design standards and toward "performance" standards.

Meanwhile, Harris said that by the end of the year, OSM will have cooperative agreements with Colorado, Montana, New Mexico, North Dakota, Utah, and Wyoming. Such pacts delegate authority to states to regulate mines on federal lands. Harris also said that OSM is working with Indian tribes to develop legislation that would give tribes the same power states have to run their regulatory programs.

Harris said one major problem is the federal law's mandate that existing operations be repermited within eight months after state regulatory programs are approved. "The States, industry and environmental community have all recognized the near impossibility of handling the repermitting problem in that short a time," Harris said.